Report No. UT-06.12

UDOT WETLAND FUNCTIONAL ASSESSMENT METHOD

Prepared For:

Utah Department of Transportation
Research and Development Division
And Environmental Division

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April 2006

1. Report No. UT- 06-12	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle UDOT WETLAND FUNCTIONAL ASSESSMENT METHOD		5. Report Date April 2006 6. Performing Organization Code
7. Author Craig Johnson, Ryan Pitts, Lori Porreca, and David Frey		8. Performing Organization Report No.
9. Performing Organization Name and Address Department of Landscape Architecture and Environmental Planning Utah State University 4005 Old Main Hill Logan, UT 84322-4005		10. Work Unit No. 11. Contract or Grant No. UDOT Contract No. 04-9044
12. Sponsoring Agency Name and Address Utah Department of Transportation 4501 South 2700 West Salt Lake City, Utah 84119		13.Type of Report & Period Covered FINAL 14. Sponsoring Agency Code JOB/PROJ NO: 81FR0214 PIC NO: UT01.301

15. Supplementary Notes

Prepared in cooperation with the Utah Department of Transportation Environmental Division, the U.S. Army Corps of Engineers Utah Division, the U.S. Fish and Wildlife Service, the Utah Department of Wildlife Resources, the Montana Department of Transportation, and the Federal Highway Administration.

16. Abstract

The Utah Department of Transportation (UDOT) Wetland Functional Assessment Method is a science-based, rapid, economical and repeatable wetland evaluation method applicable to Utah. It is based extensively on the Montana Department of Transportation's (MDT), *Montana Wetland Assessment Method* (1999), and is designed to specifically address highways and other lineal projects. The method is intended to evaluate wetland functions and values, not to delineate wetland boundaries.

The Wetland Functional Assessment Method incorporates Utah wetland types, wildlife, other Utah-specific issues, water quality, connectivity and stream type classifications. The objectives of developing this method were: 1) to meet the needs of local regulatory agencies for quantifying jurisdictional wetland functions and values inherent in the majority of proposed wetland disturbance-related projects in the state, particularly highway projects, 2) to minimize subjectivity and variability between wetland evaluators, 3) to provide a means of assigning wetlands overall ratings to facilitate the avoidance of wetlands with the highest functional value, and 4) to use some of the principles of the hydro geomorphic (HGM) assessment method in the evaluation process as an interim method if and until HGM is implemented in Utah, and as an alternative once HGM is implemented.

17. Key Words	18. Distribution Statement	23. Registrant's Seal
Wetland functions, Utah wetland types, Utah wildlife, water quality, jurisdictional wetland evaluation, playa, hydro geomorphic (HGM) assessment method	UDOT Research Division 4501South 2700 West PO Box 148410 Salt Lake City, Utah 84114-8410	

19. Security Classification	20. Security Classification	21. No. of Pages	22. Price
Unclassified	Unclassified	175	

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Utah Department of Transportation

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ACKNOWLEDGEMENTS

Preparing this handbook required the collaborative contributions of many individuals. Advisory team members played a significant role; their thoughts, suggestions and constructive criticism contributed to the handbooks organization, content and its focus on practical application in the field. Team members included:

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UDOT personnel and outside reviewers made numerous insightful recommendations. Their insistence on a scientific basis for the assessment method, practicality and consistency were most helpful. UDOT reviewers include: Terry Johnson – Landscape Architect; and Lars Anderson – Landscape Architect

Outside reviewers include:
Brian Nicholson – Wetland Specialist; Todd Sherman – Private Consultant, Wetland Specialist; Lawrence Urban – Montana Department of Transportation (MDT) Wetland Specialist; and Chris Witt – USFWS Biologist.

We also wish to express our indebtedness to the researchers and authors whose work we have referenced. They are listed in the bibliography. We are deeply indebted to Lawrence Urban for his permission to use much of the *Montana Wetland Functional Assessment Method* as a base for this publication. Also a special thanks to Nancy Keate for her sound advice on the use of the Utah Wetland Classification System and its application to functional assessment and for sharing her wetland sub-classification profiles, plant lists and photographs.

Photographs were provided by: Susan Buffler, Craig Johnson, Nancy Keate and Ryan Pitts and are noted where they occur. Cover photo credit: Craig Johnson and Ryan Pitts

Graphics are by Craig Johnson and include adaptations by David Frey of graphic work in Rosgen, D.L. 1994, *A Classification of Natural Rivers*, Catena ZZ (169-199). Ryan Pitts and Lori Porreca artfully integrated the graphic materials and text in the layout of the manual.

A special thanks to Marsha Ainscough, Rachael Johnson and Shaleece Poll for typing numerous drafts.

Funding for this project was provided by the Utah Department of Transportation using State Planning and Research funds provided by the Federal Highway Administration, and State Construction funds. We appreciate the support of both agencies.

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INTRODUCTION

In 2003, the Utah Department of Transportation (UDOT) and an advisory team that included representatives from UDOT, Utah Division of Wildlife Resources (UDWR), United States Fish and Wildlife Service (USFWS), and the Army Corps of Engineers (COE), developed a wetland evaluation method to be applied to highway projects in Utah. The method is based extensively on the Montana Department of Transportation's (MDT), *Montana Wetland Assessment Method* (1999). The MDT method has been extensively field tested and reviewed favorably by wetland professionals. Changes have been made in the MDT method to accommodate Utah wetland types, wildlife and other Utah-specific issues. In addition water quality, connectivity and stream type classifications have been added as factors or functions to be included in the assessment.

Future plans include field-testing the UDOT method for one season, incorporating several wetlands of each wetland type. Comparisons will be made between evaluation results prepared by several different evaluators to identify whether there are inconsistencies between evaluators. Where appropriate, changes will be made to the 2005 edition of the UDOT method. These instructions and field evaluation forms constitute the 2005 version of the UDOT Wetland Functional Assessment Method.

This assessment method was designed to address highways and other lineal projects. **The method is intended to evaluate wetland functions and values. It is not intended for use to delineate jurisdictional wetland boundaries. Wetland delineation should occur prior to functional assessment using the 1987 COE wetland delineation manual or other COE approved methods.**

The objective of the UDOT method is to provide a science-based, rapid, economical and repeatable wetland evaluation method applicable to Utah that:

- meets the needs of local regulatory agencies for quantifying jurisdictional wetland functions and values inherent in the majority of proposed wetland disturbance-related projects in the state, particularly highway projects.
- minimizes subjectivity and variability between evaluators.
- provides a means of assigning wetlands overall ratings to facilitate avoidance priorities (avoiding where feasible wetlands of highest functional value).
- uses some of the principles of the hydro geomorphic (HGM) assessment method in the evaluation form as an interim method if and until HGM is implemented in Utah and as an alternative once HGM is implemented. At the time of writing this handbook, no HGM guidebook for assessing the function of Utah's wetlands has been completed but there is an assessment protocol.

NOTE:

Section 404 of the Clean Water Ac es a playa as a Water of the U.S., not a wetla ecifically, playas are regulated by the C nder the provisions of the Code of Federal Regulations 33 CFR 328.3 (a) implementing Section 404 of the Clean Water Act (CWA). Federal Register 33 CFR 328.3 [a] states "The term 'waters of the United States' means (1) all waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (2) all interstate waters including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce…; (4) all impoundment of waters otherwise defined as waters of the United States under the definition; (5) tributaries of waters identified in [items] (1)-(4) [of this definition]; (6) the territorial seas; (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in [items] (1)-(6) [of this definition]". Because playas are not wetlands, the Corps does not use the 1987 Wetland Delineation Manual to delineate playas.

For the purposes of the UDOT Wetland Functional Assessment Method, playas are included as wetlands. However, for the purposes of the wetland delineations, playas are not to be delineated according to the 1987 Wetland Delineation Manual because they are not wetlands, but waters of the U.S.

METHODS

The methods presented in this assessment handbook are largely based on the MDT method prepared by J. Berglund, Western Eco Tech (1998). Potential revisions to the MDT method to address Utah-specific conditions were initially discussed at workshops conducted by UDOT and facilitated by Larry Urban, MDT. Meeting Participants included UDOT biologists, engineers, landscape architects and research personnel, UDWR wetland ecologists, and COE wetland specialists. A draft form was presented in 2004 to the Utah Interagency Group with representatives from UDOT, UDWR, COE, USFWS, the Environmental Protection Agency (EPA), private consultants and the Natural Resources Conservation Service (NRCS). The Utah Natural Heritage Program (UNHP) and the Utah Geological Survey were also consulted. The MDT method, upon which this UDOT method is based, was revised in the fall of 2004 based on comments received, meeting results and a literature review.

Primary literature sources referenced in preparation of the 1996 and 1999 drafts of the MDT wetlands assessment method include:

- Regional Guidebook for Assessing the Functions of Intermountain Prairie Pothole Wetlands in the Northern Rocky Mountains (Hauer et al. 1999)
- A Comprehensive Review of Wetland Assessment Procedures (Bartoldus 1999)
- Oregon Freshwater Wetland Assessment Methodology (Roth et al. 1993)
- Minnesota Routine Assessment Method for Evaluating Wetland Functions (Minnesota Interagency Wetland Group 1996)
- Draft Hydro geomorphic Assessment of Riverine Wetlands (Hauer and Cook 1996)
- An Approach for Assessing Wetland Function Using Hydro geomorphic Classification, Reference Wetlands, and Functional Indices (Smith et al. 1995)
- Wetland Evaluation Technique (Adamus et al. 1991)
- The Highway Methodology Workbook (COE 1995)
- Washington State Wetlands Rating System for Eastern Washington (Washington State Department of Ecology [WDE] 1991)
- Washington State Wetlands Rating System – Western Washington (WDE 1993)

FUNCTIONS AND VALUES

Wetland functions are inherent self-sustaining properties of a wetland ecosystem; they exist in the absence of associated valleys and relate to ecological properties. Flood attenuation for riverine wetlands, is an example of a wetland function. The value of a given wetland function, or combination of functions is based on society's assessment of the worth, importance or quality attributed to those functions. The COE Regulatory Division must consider impacts to wetland functions, in this case highway-related impacts, when evaluating section 404b of the Clean Water Act permit applications. The following functions and values are evaluated in the UDOT method.

- Functions
  - Biological
    - Habitat
      - Level of disturbance
      - Plant community composition
      - Federally listed or proposed Threatened or Endangered Plants or Animals or Plants or Animals rated S1 by the UNHP
      - Plants or animals rated S2, or S3 by the UNHP
      - General wildlife species
      - General fish/aquatic Species
      - Amphibians
  - Hydrological
    - Flood attenuation
    - Short and long-term water storage
    - Sediment/nutrient/toxicant retention and removal
    - Sediment/shoreline stabilization
- Values
  - Visual quality
  - Recreation/education

All functional assessment fields are included on the evaluation form for each wetland classification type. However, for some wetland types, variables within an assessment field have been added, deleted or modified. These changes reflect the inherent hydrological, biological and physical characteristics of that particular wetland type. For example, sediment/shoreline stabilization, as a variable was deleted for depressional wetlands. Depressional wetlands are typically seasonal, semi-permanent or ephemeral and are seldom subject to wave action.

USERS GUIDE

The evaluation form is similar to a dichotomous key.

STEP A

The evaluator is first asked several questions that are related to project site geography; placing the site in an ecoregion, watershed and county. Next, the evaluator determines the size and configuration of the assessment area (AA) and the expanded assessment area (EAA), using the criteria detailed in question 10 on the evaluation form and as delineated in Appendix B, Sample Assessment Areas.

STEP B

The evaluator is asked to determine whether or not the AA is documented primary habitat for species listed as threatened or endangered (T&E), as identified under the Endangered Species Act (ESA) and State listed S1 species. During the application process, if a T&E species or its habitat is identified within the project area, then the Corps may initiate Section 7 consultation with United States Fish and Wildlife Services (FWS). At that time, the FWS will either conduct a biological evaluation or a biological opinion, depending on whether a "take" may occur. The majority of the time, the consultation will prevent a "take", as long as the applicant follows certain conditions set by the FWS. Therefore, the Corps and the applicant will continue processing the application according to Corps regulations and the FWS conditions. Likewise the presence of a State listed S1 species requires consultation with UDWR and may require an addition biological evaluation on the AA.

STEP C

The evaluator is then asked to determine which one of the five Utah Wetland Classification types it belongs to or whether it meets the definition of a roadside ditch wetland. The evaluator can refer to Appendices D and E, which include wetland profiles, photographs of each wetland classification type and a list of wetland plant species typically associated with each wetland type. A definition of a non-jurisdictional roadside ditch wetland is included in the Glossary of Terms.

STEP D

If the wetland is not primary habitat for T&E species, the evaluator proceeds with the functional assessment. Return to the wetland classification type assigned to the AA in Step C. If the AA has been delineated as a non-jurisdictional roadside ditch wetland, it is automatically classified as a Category IV wetland. If the wetland meets the definition of a non-jurisdictional roadside ditch, the wetland is classified Category 4, no further evaluation is necessary. However, all necessary papers must be submitted to COE for approval and issuance of a permit prior to impacting the wetland.

STEP E

If the wetland is a jurisdictional wetland it is one of five naturally occurring types present in Utah landscapes.

Wetland Type Section Color

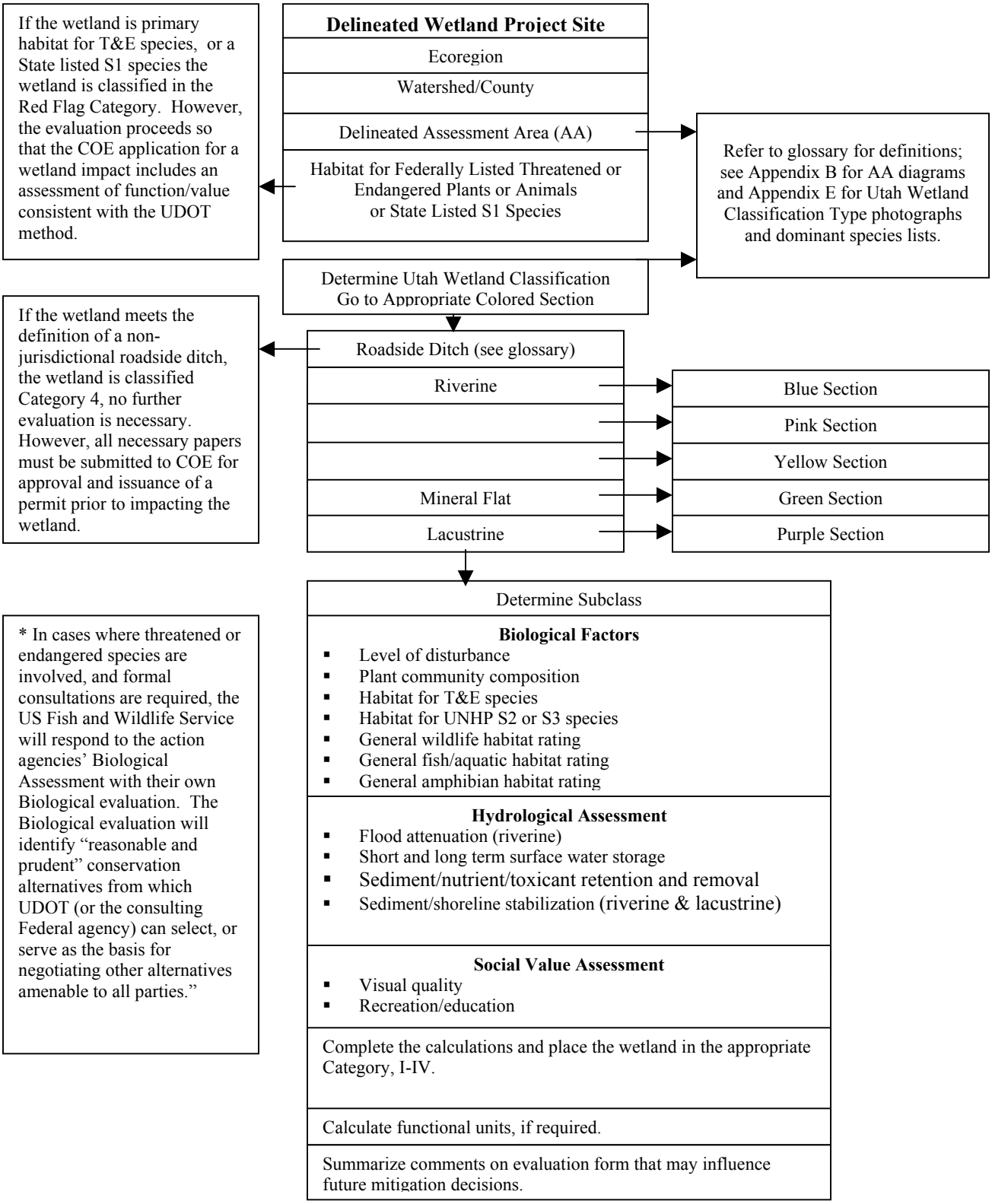
- Riverine Blue
- Slope Pink
- Depressional Yellow
- Mineral Flat Green
- Lacustrine Purple

Proceed to the colored section for the wetland classification type assigned to the AA.

STEP F

Identify the wetland subclass (if applicable) and complete the colored forms following the instructions.

WETLAND ASSESSMENT METHOD PROCESS DIAGRAM



INSTRUCTIONS AND DISCUSSION

This section of the report provides discussion and instructions for completing each of the fields on the form.

The COE Regulatory Division must consider impacts to wetland functions and values when evaluating Section 404 permit applications. Functions are self-sustaining properties of a wetland ecosystem that exist in the absence of society, and relate to ecological significance without regard to subjective human values (COE 1995). Groundwater discharge is an example of a wetland function. Values are benefits that derive from either one or more functions and the physical characteristics associated with a wetland (COE 1995). The value of a given wetland function, or combination of functions, is based on human judgment of the worth, merit, importance or quality attributed to those functions.

The following functions and values are evaluated by this method:

Functions
- Level of disturbance
- Plant community composition
- Habitat for federally listed or proposed threatened or endangered plants or animals or habitat or plants or animals rated S1 by the UNHP
- Habitat for plants or animals rated S2 or S3 by the UNHP
- General wildlife habitat
- General fish/aquatic habitat
- General amphibian habitat
- Flood attenuation (riverine)
- Short and long-term surface water storage
- Sediment/ nutrient/ toxicant retention and removal
- Sediment/ shoreline stabilization (riverine and lacustrine)

Values
- Visual quality
- Recreation/ education potential

The form assesses and assigns each of the eleven functions ratings of "low", "moderate" or "high") and scores each on a scale of .1 (lowest) to 1 (highest) "functional points." The scoring scale for each function is similar to that of HGM, although not all of the variables considered by HGM with respect to a given function were included in this method. The two value assessments (visual quality and recreation/educational potential) are not included in the scoring.

Functional points are summed on the data form and expressed as a percentage of the possible total; functions that do not apply to a given wetland are overlaid with a grey tone on the evaluation form and are assigned a rank of "NA" and are **not included** in point totals. This percentage is then used in conjunction with other criteria to provide an overall wetland ranking into one of five categories. The Red Flag Category is for AAs with documented presence of TorE plants or animals or state listed S1 species or its habitat. Category I is the highest overall ranking a wetland can receive, followed by Category II, Category III and Category IV. Functional points can be multiplied by the total existing or expected (post-project) acreage in the assessment area (AA) to determine the total "functional units" existing, expected to be lost, or expected to be gained at a given site. Wetland categories and functional units are further discussed in the latter portion of this section.

When completing questions 15a through 15k (the functions assessment portion of the form), if it is the evaluator's best professional opinion that a rating for a particular function is inadequately represented on the form due to specific site conditions, it is appropriate to override the calculated value and note the justification in the comment space provided. It is important to note, however, that this should be treated as the exception rather than the rule.

Generally, it is appropriate to assess wetlands, or assessment areas (AA), individually on separate data forms. However, it is also appropriate to address several AAs on one data form if the AAs are similar with respect to size, compositions, exposure to disturbance, and other features. AAs that differ enough from one another such that they would result in different ratings for various functions and values should be assessed on separate data forms.

Several attributes throughout the form are rated by working through matrices. Variables used within these matrices are addressed in a dichotomous, "top to bottom" fashion, resulting in an assignment of functional points and a rating for each evaluated function.

THE ASSESSMENT FORM

1. Project Name
Enter the appropriate project name.

2. Project Number
Enter the appropriate project number, if applicable.

3. USCOE Permit Number and Project Pin Number: Enter the appropriate control numbers, if applicable.

4. Evaluation Date
Enter the date(s) that the field evaluation was conducted.

5. Evaluating Agency
Fill in the appropriate agency (for UDOT projects, this will generally be "UDOT")

6. Evaluator(s)
Enter the names and/or affiliation of the personnel conducting the evaluation.

7. Purpose of Evaluation
Check the appropriate project category.

8. Wetland/ Site Number(s)
Enter the wetland identification number(s) e.g., Fish Creek), if applicable.

9. Wetland Location(s)
Enter the appropriate ecoregion, watershed, county, legal description, stationing or mileposts and the eight-digit watershed descriptor (U.S. Department of the Interior, U.S. Geological Survey 2002, http://ut.water.usgs.gov/gis/hub.html), global positioning satellite (GPS) reference number (if available, not required), and other desired location information for the evaluated wetlands.

10. Wetland Size
Enter the estimated or measured (not required) size of the entire wetland that includes the assessment area (AA). If the AA is delineated such that the entire wetland is included, the responses to 8 and 9 will be the same. If evaluating more than one AA on a single data form, enter the average wetland size or the range of wetland sizes.

11. Assessment Area (AA)
Indicate the estimated or measured (not required) acreage within the boundaries of the AA using the guidance below. If splitting a wetland into more than one AA, indicate the AA boundaries on the wetland delineation map. Wetlands bisected by roads are considered as a single AA. If evaluating more than one AA another data form will be needed. Several example Assessment Areas relative to highway projects are provided in Appendix B.

The AA includes only the portion of delineated jurisdictional wetland that is within a proposed project zone, right-of-way, construction easement, permit area, known detour area, etc.

11a Expanded Assessment Area (EAA)
This area is determined by extending all boundaries of the AA (the portion of the delineated jurisdictional wetland that is within a proposed project zone, right-of-way, construction easement, permit area, known detour area, etc. to a distance of 600 feet. Wetlands with open water that have not been delineated as jurisdictional wetland, apply A or B to determine the EAA.

A contiguous up and downstream from the project to physical points of significant hydrologic change (natural [geomorphic] or man made constrictions or expansions, points where the gradient changes rapidly, points of significant inflow) [e.g., tributaries] or places where other factors limit hydrologic interaction *or*

B contiguous up and downstream from the project to a maximum distance of 600 feet if no points of significant hydrologic change (including termination of the wetland) occur within this radius.

This "expanded" area is used to evaluate contextual factors such as level of disturbance that may affect wetland function. For riverine wetlands the EAA is extended 600 feet perpendicular to the stream channel and is extended upstream and downstream as determined by A or B.

12. Habitat for Federally Listed or Proposed Threatened or Endangered Plants or Animals and State Listed S1 Species
A "red flag" attribute, this field assesses habitat for species receiving protection under provisions of the Endangered Species Act; that is, listed or proposed threatened or endangered species. Potential effects to threatened and endangered species are examined by the COE during 404 permit application reviews. According to the COE general conditions for Nationwide 404 permits, "no activity is authorized which is likely to jeopardize the continued existence of a threatened or endangered species or a species

proposed for such designation, as identified under the Endangered Species Act or which is likely to destroy or adversely modify the critical habitat of such species". The most current list of threatened and endangered species for Utah and state listed S1 species can be found at: http://dwrcdc.nr.utah.gov/ucdc/ Presence must be observed and recorded by a qualified observer. State listed S1 (although S1 species do not receive protection by statute they should be given special consideration) species should also be considered in Step 12. It is recommended that the evaluator contact the U. S. Fish and Wildlife Service with regard to presence or absence of threatened or endangered species and UDWR for presence or absence of state listed S1 species.

Primary Habitat: Habitat essential to the short or long-term viability of individuals or populations. The presence of traditional breeding, spawning, nesting, denning or critical migratory habitat, large seasonal congregations (including communal roosts, staging habitat, traditional foraging congregations, etc.), or USFWS or UDWR - designated critical habitat or core areas in the AA indicates primary habitat, as does any occurrence of a T&E plant or S1 species. If T&E or S1 species habitat is documented at the AA, indicate the source of the documentation.

As previously noted, if the project site is documented habitat for TorE species or state listed S1 species it is assigned to the Red Flag Category. In cases where threatened or endangered species are involved and formal consultations are required, the FWS will respond to the action agencies Biological Assessment with their own Biological Evaluation. The Biological Evaluation will identify "reasonable and prudent" conservation alternatives from which UDOT or the consulting agency can select, or serve as a basis for negotiating an alternative amenable to all parties. If the AA is not documented primary habitat for threatened or endangered species or state listed S1 species and the AA is not automatically classified in the Red Flag Category, it may nevertheless be an important habitat component for them. Thus in question 15c, the evaluator will be asked to determine whether the AA is primary suspected habitat, secondary documented or suspected habitat, or incidental habitat for threatened or endangered species or S1 species.

13. Selecting a Wetland Classification

Wetland classes found in Utah are riverine, slope, depressional, mineral flats, and lacustrine. A classification hierarchy showing systems, subsystems, classes and subclasses for Utah Wetland Classification (UWC) is provided in Keate (2004) Appendices D and E.

For number 13, enter the UWC that applies to the AA using the UWC (Keate 2004) classification system.
Note: topographic maps and aerial photographs should be studied prior to field evaluation to assist in determining wetland classification.

- **Riverine wetlands:** Occur in floodplains and riparian corridors in association with stream channels. Water source is river or stream flow or overbank flow at peak hydrological periods. (Overbank flow should occur once every two years or 50% of the time. If flooding does not occur at this minimal rate, it is probably not a riverine based wetland). Dominant hydrodynamics are unidirectional and horizontal. A subsurface hydraulic connection between the wetland and stream does not necessarily indicate a riverine system.
- **Slope wetlands:** Occur at points of surface changes, breaks in slope or stratigraphic changes. Surface water runoff and groundwater outflow (i.e. – spring or seep) are the primary water sources. Water flow is unidirectional (down slope/gradient). Water may discharge to a stream, lake or depression. Wetland complexes can be comprised of a slope wetland with several depressions or low-points interspersed throughout. Relying on topographic maps, aerial photographs, and field evaluation will help determine which classification is dominant and or most appropriate.
- **Depressional wetlands:** Occur in topographic depressions with closed contours. Water sources are precipitation, runoff and groundwater. Water flow vectors are toward the center of the depression. Dominant hydrodynamics are vertical. May or may not have inlets or outlets. Depressions that are full, may release water down slope/gradient and tend to be a part of a larger slope complex. Relying on topographic maps, aerial photographs, and field evaluation will help determine which classification is dominant and or most appropriate.
- **Mineral Flat wetlands:** Occur on large relict lakebeds. Dominant water source is precipitation. Dominant hydrodynamics are

vertical. Typically are large features in the landscape, associated with old Lake Bonneville bottom deposits with close proximity to GSL or other large permanent, semi-permanent or ephemeral water bodies. (e.g. – Sevier Lake) Only found in basin and range ecoregions. Example: Great Salt Lake mud flats and salt flats. Subclasses are not known.

- **Lacustrine Fringe wetlands:** Occur adjacent to large lakes and reservoirs. Dominant water source is lake water level. Hydrodynamics are bi-directional. Subject to waves and seiches.
- **Roadside Ditch Wetland:** Any non-jurisdictional wetland <30 feet in width that exists in its entirety within the highway ROW, is an excavated upland and is not connected to any other jurisdictional wetland. Its primary source of hydrology is runoff from the road surface, irrigation overflow, irrigation ditch leakage or non-point surface runoff from an adjacent urbanized area. In addition, to qualify as a roadside ditch wetland the wetland of concern must **not** convey water to any adjacent natural stream, spring or natural or created wetland outside the ROW and must not contain any threatened or endangered species.

14. Subclassification
Identify the subclass, soil type, pH range and water salinity if applicable to the particular wetland class. For detailed subclass information for see Appendices D and E.

15a Level of Disturbance
Disturbance: This field assesses the level of disturbance within the wetland (AA) and the level of disturbance within the expanded assessment area (EAA). The EAA is a 600 foot buffer around the perimeter of the AA. Disturbance at the AA is defined based on land use both at the AA and in the surrounding area (EAA). Land use in surrounding areas can provide a measure of disturbance within AAs and negatively influence their habitat quality even though the AAs themselves may be relatively undisturbed.

Circle the description of the level of disturbance that most closely reflects conditions observed within the AA and the EAA.

Comments: Provide a brief (1 to 2 sentence) descriptive summary of the AA and surrounding area. The description may include dominant species, adjacent land use, proximity to other wetlands, etc.

15b Plant Community Composition
Using the table provided in Appendix G to determine plant community composition for the AA. Plant community composition is defined as layers of vegetation (riverine and lacustrine only), percent ground coverage dominated by native wetland vegetation within the entire AA, and the percent of native wetland to non-native or non-wetland plant species. Observation is used determine layers of vegetation (riverine and lacustrine only) as well as to estimate percent ground cover dominated by native wetland species in the AA. Estimates of each of these factors are compared with reference standard sites with subclasses as described by Keate (2004) for slope, depressional, and mineral flat wetland classes. (see Appendices D, E and F for lists of dominant native vegetation, photographs, plans and cross sections). Reference standard sites for riverine and lacustrine were developed from research by Pagette et al. (1989). For riverine and lacustrine wetlands, first determine site elevation then reference Appendix F.

The native wetland to non-native or non-wetland plant percent is obtained by using transect sampling procedures detailed in Appendix G. The evaluator divides the total number of native wetland plant species by the total number of plants observed.

It is important to note that in some circumstances it may not be possible to conduct a transect protocol as described in Appendix G. For example, heavily wooded areas along a riverine corridor, small size of the AA or fragmented pieces of jurisdictional wetland scattered over the project site. In these circumstances the evaluator(s) should visually assess the vegetation and use their best professional judgment.

15c Habitat for Federally Listed or Proposed Threatened or Endangered Plants or Animals
This field assesses primary suspected, secondary documented or suspected or incidental documented or suspected use of the AA by federally listed or proposed threatened or endangered species, or documents the AA as unsuitable habitat for threatened or endangered species.

i. Circle S to indicate whether habitat for listed or proposed TorE species is suspected within the AA at the ascertained level using the definitions provided below. It may be appropriate to indicate more than one use level for multiple species. For example, an AA may contain secondary habitat for bald eagles and incidental habitat for peregrine falcons. List the

species that correspond to each habitat level determined to apply to the AA.

Secondary Habitat:
Habitat that is occasionally or semi-regularly used by a given species, but that is not necessarily essential to the short or long-term viability or individuals or populations. Examples would include non-specific migration areas and occasional forage or perch sites. Primary habitat, as defined above, may occur in the general vicinity (e.g., within the project area, EAA, section, drainage, watershed, etc.), but not in the AA.

Incidental Habitat:
Habitat that receives chance, inconsequential use by a given species or habitat conditions or the known distribution of the species would indicate this level of use. This term implies that, while it may be conceivable that a given species may occur at an AA at a given point in time, the chance is remote and the use is not likely to be repeated.

ii. Rating: Use the highest level habitat (e.g., the level that corresponds to the highest functional point value) determined under **i** to determine the functional point value for the AA. If the AA is not documented Primary Habitat for threatened or endangered species and the AA is not automatically classified as a Category I, it may nevertheless be an important habitat component for them. Thus in question 15c, the evaluator will be asked to determine whether the AA is secondary or incidental habitat for threatened and endangered species.

15d Habitat for Plants or Animals Rated S1, S2, or S3 by the Utah Natural Heritage Program
This field assesses use of or existence in the AA by species rated S2 (imperiled), or S3 (vulnerable) by the UNHP (not including "watch list" species). S1 (critically imperiled) species would have been placed in the Red Flag Category in Step 12. Species within these UNHP categories are inclusive of U.S. Forest Service-listed sensitive species and FWS candidate species that are not subject to the provisions of the Endangered Species Act. To avoid duplication, do not include species listed above under 12 and 15c. Evaluators are encouraged to contact the Utah State University Herbarium (435) 797-1584 if they have T or E plant identification questions. Contact UDWR (801) 538-4700 for plant and wildlife questions and documentation.

i. Circle D or S to indicate whether habitat for these species is documented or suspected within the AA at the ascertained level using the definitions provided above under 12 and 15c or in the glossary. As discussed in 12, it may be appropriate to indicate more than one habitat level for multiple species. List the species that correspond to each habitat level applying to the AA.

ii. Rating: Use the highest level habitat (e.g., the level that corresponds to the highest functional point value) determined under **i** to determine the functional point value for the AA. If sensitive species habitat is documented at the AA, indicate the source of the documentation.

15e General Wildlife Habitat
This field assesses general wildlife habitat potential within the AA based upon documentation of wildlife use and habitat features. The combination of these two variables is considered to more accurately assess this function than if habitat features alone were used. A site may contain what are perceived to be outstanding habitat features for wildlife, but for reasons difficult to detect (such as presence of toxins, etc.) may only receive minimal to moderate use. Opportunities for enhancement may exist if such a situation were correctable. Conversely, a site may contain few desirable habitat features, but may receive significant use due to a general lack of habitat in the area or other factors and may be under-rated for this function if documented wildlife use was not considered.

Degree of disturbance at a wetland and in the adjacent landscape can greatly influence its use by wildlife. Examples of disturbance include direct conversion, conversion of upland supporting habitats, and encroachment and fragmentation by human activity sources, such as buildings, trails, roads, canals and ditches.

Plant community composition relates to the number of niches in a wetland class as well as its vertical and horizontal structural characteristics as described in the reference standard site. More niches are potentially available as more layers of habitat occur within the range of expected layers for native vegetation and structural characteristics in a given wetland class, so more wildlife species potentially are supported by more structurally complex habitats.

ii. Wildlife Habitat Features: Working from top to bottom within the double vertical lines, circle the appropriate AA attributes in the matrix provided on the data form to arrive at a high (H), moderate (M), or low (L) rating. The first variable considered is the

level of disturbance. The second variable is plant community composition.

Modified Habitat Quality Rating: Consult with the UDWR regional wildlife biologist to determine the level of wildlife use in the AA.

Circle "high" "moderate" or "low" level of use based on the data collected and following consultation with the UDWR regional biologist. For further guidance, refer to the definitions of high, moderate or low to no use provided below. Evidence of use is considered to be indicative of level of use.

High use:
AA is regularly used in high numbers relative to local or transient populations.

Moderate use:
AA is regularly used in small to moderate numbers relative to local populations, or infrequently or sporadically used in any numbers relative to local or transient populations.

Low to No use:
AA regularly, infrequently or sporadically used by extremely small numbers relative to local populations, or receives chance, inconsequential use in any numbers relative to local or transient populations.

iii. Rating: Determine and circle the general wildlife habitat rating and functional points for the AA by applying the results of **i** and **ii** to the matrix provided in the data form.

15f General Fish/ Aquatic Habitat
This field assesses general fish and aquatic habitat at the AA based upon the presence of certain groups of fish and habitat features. In Utah this only applies to riverine and lacustrine wetlands. Assess this function only if the AA is used by fish or the existing situation is "correctable" such that the AA could be used by fish (e.g., fish use is precluded by perched culvert or other barrier, etc.). If the AA is not or was not historically used by fish due to lack of habitat (including duration of surface water), excessive gradient, etc. (e.g., the AA does not have the opportunity to provide habitat for fish), circle **NA** where indicated on the data form and proceed to the next function. The maximum duration of surface water (any water above the ground surface that is available to wildlife; not necessarily open water) covering at least 10% of the AA. The 10 percent criterion should be considered a rule of thumb and is intended to be applied primarily at smaller (e.g., less than 1 or 2 acres), rather than larger sites. For example, 9 acres of surface water should not be dismissed at a 100-acre AA simply because this 10 percent guidance is not met. The intent of this criterion is to allow consideration of significant surface water amounts within an AA relative to fish habitat, while disallowing insignificant surface water amounts. The final call will depend on the specific situation at hand, and is therefore left to the evaluator. Abbreviations for surface water durations are as follows: P/P = permanent/ perennial; S/I = seasonal/ intermittent; T/E = temporary/ ephemeral; and A = absent where:

Permanent/ perennial:
Surface water is present throughout the year except during years of extreme drought.

Seasonal/ intermittent:
Surface water is present for extended periods, especially early in the growing season, or may persist throughout the growing season, but may be absent at the end of the growing season; or surface water does not flow continuously, as when water losses from evaporation or seepage exceed the available stream flow.

Temporary/ ephemeral:
Surface water is present for brief periods during the growing season, but the water table is well below the surface for most of the year; or surface water flows briefly in response to precipitation in the immediate vicinity and the channel is above the water table.

Variables assessed to determine a rating for habitat quality include duration of surface water, structural cover, shading, and habitat availability. Presence of surface water is an obvious critical component of fish habitat. Seasonally flooded areas can be important nursery and foraging areas for fish (and can result in "high" habitat quality ratings using this assessment); however, longer duration of surface water generally results in higher ratings because surface waters of such duration are available to fish for greater periods and varieties of life stages. Flow or water level stability is an important habitat component for a variety of fish species.

Abundant structural cover and well-vegetated stream banks and shorelines are also important habitat components for several fish species. Structural cover such as submerged logs and vegetation, other woody debris, floating-leaved vegetation, and large rocks provides resting areas, refuge from predators, hiding

areas from predators, and functions as a substrate for insect larva; an important food source for many fish species. High water temperatures that result from removal of streamside vegetation can render habitat as unsuitable for fish that are sensitive to higher temperatures, such as Bonneville cutthroat trout. Vegetation along streams, ponds, and lakes also provides insect habitat, an important food source for many fish species.

Although the physical habitat attributes of a site may be attractive to fish, use of the area may be significantly reduced or precluded due to the presence of inadequately sized culverts, dikes, continual sources of degradation, or other causes. Consequently, potential "habitat modifiers" are also considered in the assessment.

The presence of certain groups of fish in the AA is considered along with habitat features to derive an overall fish/ aquatic habitat rating. UDWR seeks to preserve and enhance all desirable aquatic species and their supporting ecosystems. To accomplish this UDWR continues to develop and implement policies and programs that foster sound management of wild fish populations and their habitats, at the same time that it monitors and regulates angler harvests, maintains recreational activities for anglers, and provides improved access to fisheries.

Given these management priorities (managing for wild fish populations **and** recreational opportunities), the following groups of fish are considered in the assessment in order of descending "rank:" native game sport fish; introduced game fish; non-game fish; and no fish.

As listed in the 2004 Utah Fishing Proclamation, Utah native sport fish include: Mountain, Bonneville and Bear Lake Whitefish, Bonneville Cisco and four subspecies of Cutthroat Trout, Bear Lake, Bonneville, Colorado and Yellowstone. Non-native coldwater sport species include: Rainbow Trout, Lake Trout, Brook Trout, Arctic Grayling, Kokanee Salmon and Brown Trout. Cool and warm water sport fish include: Walleye, Yellow Perch, Striped Bass, White Bass, Smallmouth Bass, Largemouth Bass, Bullhead, Channel, Catfish, Black Crappie, Green Sunfish and Bluegill. Hybrid sport fish include: Tiger Muskelunge, Tiger Trout and Splake. Non-game fish include: Carp, Utah Sucker and Utah Chub. The June Sucker is an endangered species. Threatened species and state species of concern can be found at http://dwrcdc.nr.utah.gov/ucdc/.

i. Habitat Quality: Working from top to bottom within the double vertical lines, circle the appropriate AA attributes in the matrix provided on the data form to arrive at a high (H), moderate (M), or low (L) rating. The first variable considered is the maximum duration of surface water in the AA. Use the definitions provided above. The second variable is structural cover. Estimate the percentage of the waterbody within the AA that contains cover objects such as submerged logs, large rocks and boulders, overhanging banks, and submerged and floating-leaved vegetation. The final variable is shading, as determined by estimating the percent of stream bank or shoreline within the AA that contains wetland or riparian scrub-shrub or forested communities. This will determine the rating for habitat quality.

ii. Modified Habitat Quality: Circle the appropriate response to the following question: Is fish use of the AA precluded or significantly reduced by a culvert, dike, or other man-made structure or activity **or** is the waterbody included on the UDEQ list of waterbodies in need of TMDL development with listed "Probable Impaired Uses" including cold or warm water fishery or aquatic life support? If the answer is yes, then reduce the habitat quality rating determined in **i** above by .1. If the answer is no, then do not modify the habitat quality rating determined in **i**.

iii. Rating: Determine and circle the general fish/ aquatic rating and functional points for the AA by applying the results of **i** and **ii** to the matrix provided in the data form. The term "native" implies a species indigenous to Utah; not necessarily to a given drainage or water body. The evaluator is referred to *Fishes of Utah* (Sigler and Miller 1963) for the status (native vs. introduced) of fish species known or suspected to occur in the AA.

15g Amphibian Habitat

This field assesses general amphibian habitat potential at the AA. The assessment is based upon the presence of water quality and habitat characteristics that could support amphibians or document amphibian use of the AA. The level of amphibian use of the AA or the potential of the AA to support amphibians is determined through consultation with a UDWR regional biologist. If amphibians are present in the AA or habitat and water quality characteristics are such that they could support amphibians add .2 under the functional points rating column in the Functional Assessment Rating section.

15h Flood Attenuation
This field assesses the capability of jurisdictional wetlands in the AA to slow in-channel or overbank flow during high water/flood events. This parameter applies only if the AA is classified as a riverine wetland or contains a discernible floodplain (e.g., is subject to flooding and possesses the opportunity to attenuate flood waters), based on floodwater proximity, evidence of flood deposits, FEMA maps, etc., and can apply to any AA that includes a flowing water/channel component (e.g., rivers, streams, flowing ditches). If a jurisdictional wetland within the AA does not occur within a channel or discernible floodplain, circle **NA** where indicated on the form and proceed to the next function.

The variable used to assess this function is surface roughness in the AA. Surface roughness features for riverine wetlands include emergent wetland, deep rooted woody and or tall sturdy herbaceous vegetation (e.g. stream bank wheatgrass) and may also include course woody debris, litter, boulders, rock outcroppings and micro topography. Riverine wetlands with a high percentage of aerial coverage of these features are better able to retard flood waters than are wetlands with moderate or low surface roughness. (See glossary for roughness definitions)

i. Rating: Working from top to bottom, use the matrix on the data form to arrive at [circle] the functional points and rating [H=high, M=moderate, or L=low] for this function.

Estimate surface roughness in the AA using the definitions in the glossary. Do not include non-wetland open water channel in this estimate. Circle the appropriate rating and functional points.

ii. Indicate whether there are residences, businesses, or other features (parks, sports fields, historic sites, roads, etc.) that could be damaged by floodwater located within 0.5 miles downstream of the AA. Describe these features in the comments section.

15i Short and Long Term Surface Water Storage
This field assesses the potential of the AA to capture and hold surface water originating from precipitation, upland surface (sheetflow) or subsurface (groundwater) flow. If jurisdictional wetlands in the AA are not subject to inundation or ponding, circle **NA** where indicated on the data form and proceed with the evaluation.

Variables used to assess this function are: frequency of inundation or ponding and whether or not the wetlands natural ability to store water has been disturbed negatively. Wetlands that pond frequently provide water storage functions more often than do wetlands that pond less frequently. Duration of water retention is implied in the wetland class or subclass definition. Also wetlands whose natural hydrology has not been modified by dikes or drains retain their inherent ability to store surface water.

i. Rating: Working form top to bottom, use the matrix on the data form to arrive at [circle] the functional points and rating [H=high, M=moderate, or L=low] for this function. First estimate (based on photographs, NRCS data, interviews, knowledge of the area, etc.) whether the jurisdictional wetlands that flood or pond do so at a frequency greater than or less than five out of every 10 years and circle the appropriate functional points and rating. Then determine whether the wetland's natural ability to store water has been disturbed negatively.

15j Sediment/ Nutrient/ Toxicant Retention and Removal
This field assesses the ability of the AA to retain sediments and retain and remove excess nutrients and toxicants. This field only applies to wetlands which could receive sediments and excess nutrients or toxicants through influx of surface or ground water or direct input. If no wetlands in the AA are subject to such input, circle **NA** where indicated on the data form and proceed with the evaluation. Nitrogen and phosphorus are the two nutrients most often associated with water pollution; both occur in high concentrations in fertilizers and discharges from sewage treatment plants and livestock operations, and excessive amounts of either can result in algal blooms and subsequent oxygen deficiencies in receiving waters. Toxicants include pesticides, herbicides, petroleum products, metals and other potentially harmful constituents.

The assessment is based on the site's proximity to sediment/nutrient/toxicant sources; plant community composition; evidence of flooding or ponding; and presence or absence of an outlet. Wetlands which could receive and successfully process sediment, nutrients, and toxicants provide these functions at a higher capacity than do wetlands that receive excessive amounts of these constituents such that other functions are impaired. Generally, a wetland's ability to uptake nutrients and toxicants and filter sediment increases with the density of its vegetation within its expected range of percent cover. Flooded or ponded wetlands are indicative of sites that retain water; these areas allow sediments to settle out and

increase nutrient/toxicant contact time with vegetation, facilitating uptake. Sites whose natural ability to store water have not been altered in a negative way, retain their ability to perform settling and uptake functions.

i. Rating: Working from top to bottom, use the matrix on the data form to arrive at [circle] the functional points and rating [H=high, M=moderate, or L=low] for this function. First, determine if the AA receives or surrounding lands have the potential to deliver low to moderate levels of sediments, nutrients, or toxicants such that other functions in the AA are not substantially impaired (e.g., the wetland is processing these inputs but is not significantly affected by them). Observation of some sedimentation, relatively minor potential sources of nutrients or toxicants, or signs of minor to moderate eutrophication would be indicative of this input level.

If the AA is in close proximity to or receives input from or is listed on the UDEQ list of Utah's 2004 303(d) List of Impaired Waters (UDEQ 2004) with listed "probable causes" related to sediment, nutrients or toxicants (e.g., not based exclusively on flow alteration, other habitat alterations, etc.), then the second column of the matrix should be used. Such related probable causes include "metals," "nutrients." "organic enrichment/DO", "suspended solids", "unionized ammonia." "priority organics," "siltation," "other inorganic," "salinity/TDS/chlorides," etc. The impaired waterbody list is lengthy and dynamic and is not included as an appendix to this document; however, the list is available at: http://waterquality.utah.gov.
If the AA is not included on the UDEQ TMDL list, but high levels of these inputs are observed or expected and are impairing other functions at the AA, as evidenced by observations of land use, major sedimentation, major contaminant sources, major eutrophication, etc., then the second column of the matrix should be used. The next variable addresses the percent of high to moderate surface roughness. The final variable determines if the wetland's ability to store water has been altered in a negative manner.

15k Sediment/Shoreline Stabilization
This field, (applicable to riverine and lacustrine wetlands), assesses the ability of the AA to dissipate flow or wave energy, reducing erosion. Complete this field only if the jurisdictional wetland within the AA occurs on the shoreline of a standing water body that is subject to wave action or on the banks of a river stream or, other natural or manmade channel. Variables to consider when determining if a waterbody is subject to wave action include estimated wind velocity, water depth and fetch (distance across the water). Although not required for application of this assessment method, Linsley and Franzini (1979) cite the following equation for determining wave height: rise of wave (ft) = [(wind velocity [mph])2 x fetch (miles)] / (1,400 x water depth [ft]). If this field does not apply, circle **NA** where indicated on the data form and proceed to the next function.

The variable used to assess this function is surface roughness in the AA. Surface roughness for lacustrine wetlands include emergent wetland, deep rooted woody, and or tall hardy herbaceous vegetation (e.g. stream bank wheatgrass) and may also include coarse woody debris, litter, boulders, rock outcroppings and micro topography. Lacustrine wetlands with a high percentage of aerial coverage of these features are better able to dissipate wave energy than are wetlands with moderate or low surface roughness. (See glossary for roughness definitions). Estimate surface roughness in the AA using the definitions in the glossary. Next, determine the duration of surface water in the rooted zone. Lakes, reservoirs, and rivers or streams where water in the root zone is permanent have more vigorous plant communities which provide better shoreline stabilization than reservoirs or streams where summer draw-downs stress vegetation increasing plant mortality and unvegetated slopes are exposed to wave and flow induced erosion.
i. Rating: Working from top to bottom, use the matrix and the data form to arrive at [circle] the functional points and rating [H=high, M=moderate, or L=low] for this function. First, estimate surface roughness with respect to herbaceous species. Annual plants are considered individually. Sedges and rushes, for example, are considered to provide deep, binding root-masses, while Kentucky bluegrass is not. Next, determine whether the duration of surface water adjacent to rooted vegetation in the AA using the definitions provided above is permanent or seasonal and circle the appropriate functional points and rating.

Groundwater Discharge/Recharge
Groundwater discharge and recharge only occur in some subclasses of Utah wetlands. Playas provide neither discharge nor recharge. Slope wetlands are usually groundwater discharge. Neither discharge nor recharge are common in Utah and hence have been deleted from functional assessment.

16 Visual Quality*
Wetlands are a visual resource. This field assesses the importance of the AA to the overall visual quality of the adjacent landscape. The assessment distinguishes between "wildland" and "urban/exurban" wetlands. Any type of wetland that has experienced low to moderate levels of disturbance and is devoid of human structures such as roads, debris, rubble, etc., have higher visual quality than wetlands with these intrusions.

Two additional factors are used for assessment of "urban/exurban" wetlands; potential number of viewers and viewing distance. Wetlands seen by many viewers are assumed to have higher aesthetic value for a larger segment of society than wetlands viewed by few. In addition, research suggests that wetlands that are observed as foreground or middle ground in the viewshed are of higher aesthetic value than background wetlands (see glossary). Further, public ownership of wetlands, either rural or urban provides a higher probability of resource management that will preserve, enhance or restore the visual resource.

The rating is based on the evaluator's assessment of the wetland's aesthetic attributes, visual accessibility and ownership. Ratings for visual quality are not used in calculating overall wetland functional ratings. Rather they are an estimate of a wetlands value to society.

17 Recreation/Education Quality*
This field assesses the potential of the AA to provide recreation/education opportunities. A wetland, which is presently used for recreation and/or education or is in public ownership has a greater probability of continuing to provide recreation/education opportunities. In addition, close proximity to educational facilities and wetland site accessibility by various modes of transportation increases the recreation and/or education value of a wetland.

The rating is based on the evaluator's assessment of the wetland's potential for recreation and/or education. Ratings for recreation and/or education potential are not used in calculating overall wetland functional ratings. Rather they provide an estimate of a wetland's value to society.

*NOTE: In some cases wetlands may contain plant or wildlife species or perform functions that would be diminished by human activity. In these cases recreational and educational activities would be prohibited.

Function & Value Summary and Overall Rating
Transfer the ratings and functional points assigned for each of the 12 functions in items 15c through 15k to the appropriate fields on the summary form. Record values of 1 under the Possible Functional Points column for functions that apply to the AA but for which no default values appear on the form. For functions that do not apply to a given AA (e.g., flood attenuation), enter "NA" under each of the column headings.

If desired, calculate the functional units for each function by multiplying the actual functional points by the estimated acreage in the AA (from 11). This is optional and will not affect the site's overall rating. In some cases, such as when more than one site is assessed on a single form, it is best to leave this column blank and derive a separate table or other means to depict functional units. Record the totals from the Actual Functional Points, Possible Functional Points, and Functional Units columns (if completed) in the Totals row. Calculate the percentage of the possible functional points that the AA achieved using the following equation: % of possible = total actual functional points / total possible functional points x 100. Determine the appropriate overall rating (described below) based on the criteria indicated on the form.

Red Flag Category
This category is for AA's in which a threatened and or endangered species or its habitat has been documented. Processing the application follows a somewhat different procedure. The COE may decide to initiate Section 7 consultation with the USFWS. UDOT may consider design modifications to prevent a "take" or follow certain conditions set by USFWS. Therefore, completion of the evaluation of the AA is required and the COE will continue processing the application according to COE regulations and USFWS conditions. State listed S1 species should also be included in this category since their presence requires consultation with UDWR.

Category I
Category I wetlands are of exceptionally high quality or are important from a regulatory standpoint. Category I wetlands can: represent a high quality example of a rare wetland type; provide irreplaceable ecological functions (e.g., are not replaceable within a human lifetime, if at all); exhibit exceptionally high flood attenuation capability; are rated exceptionally high for Plant Community Composition or are assigned high ratings for most of the assessed

functions. To be rated as a Category I site, the AA must:

- Score .9 functional points for primary documented S2 species or .8 primary suspected for S2 species; **or**
- Score 1 functional point for Flood Attenuation (riverine wetlands only) (e.g., contains riverine wetlands with a ≥ 65% aerial coverage of high surface roughness); **or**
- Score 1 functional point for Plant Community Composition; **or**
- Total functional points > 80% (round to nearest tenth) of total possible functional points.

Category II
Category II wetlands are more prevalent than Category I wetlands, and are those that provide habitat for sensitive plants or animals, function at very high levels for wildlife/fish/amphibian habitat or are assigned high ratings for many of the assessed functions and values. To be rated as a Category II site, the AA must not qualify as a Category I site and:

- Score ≥ .9 functional point for General Wildlife Habitat (e.g., habitat quality is high and or there is documented evidence of high or moderate levels of wildlife use; **or**
- Score ≥ .9 functional point for General Fish/Aquatic Habitat (riverine or lacustrine only) (e.g., contains native game fish and habitat quality is high or contains introduced game fish and habitat quality is high) and or there is documented evidence of amphibians present; **or**
- Score .9 functional points for primary documented S3 wetland community that is common in the watershed but with low disturbance/fragmentation; **or**
- Score .8 functional points for Plant Community Composition; **or**
- Total actual functional points > 65% (round to nearest tenth) of total possible functional points.

Category III
Category III wetlands are more prevalent, they generally have moderate to low Plant Community Composition rating and have a higher level of disturbance than Category I and II wetlands. They can provide many functions and values, although they may not be assigned high ratings for as many parameters as are Category I and II wetlands. To be rated Category III site, the AA must not qualify as a Category I, II or IV site.

Category IV
Category IV wetlands are generally small, isolated, and are rated low for Plant Community Composition. These sites provide little in the way of wildlife habitat. To be rated as a Category IV site, the AA must not qualify as a Category I, II or III site and:

- Achieve a Low rating for Plant Community Composition; and
- Total actual functional points < 30% (round to nearest tenth) of total possible functional points

The overall rating can be used to establish wetland avoidance/protection strategies at the project level. For example, if wetland impacts are unavoidable for a given project, and alternatives are available such that a choice can be made between affecting a Category I or a Category III site, the applicant and reviewing agencies could direct impacts to the Category III site. Other applications of the overall rating concept may include the eventual development of mitigation ratio policy

Functional units are not used in determining the overall rating, but are provided for the evaluator's consideration in assessing project impacts, mitigation needs, or in assessing mitigation plans or the success of constructed projects. An example of how functional units could be used to develop mitigation that would replace overall (cumulative) functions and values for a given project is presented as follows. The total actual functional points for a given 8-acre AA is 6.3. Total functional units for the AA would be calculated by multiplying 6.3 points x 8 acres = 50.4 functional units. A proposed highway project would impact 2 acres of the AA. Assuming a relatively uniform distribution of functional capacity across the AA, the loss in functional units to the AA would be 2 acres x 6.3 points = 12.6 functional units. To compensate for lost wetland functions and values, mitigation would need to be designed that would replace the 12.6 functional units. If the predicted total actual functional points for a mitigation project was 5.1, and the goal was to replace12.6 functional units, the applicant would need at least 2.5 acres of mitigation to compensate for the loss (2.5 x 5.1 =12.6). If limited to a two-acre mitigation site, the applicant could, in theory, design the mitigation project such that the predicted functional points met or exceeded 6.3, resulting in the replacement of at least 12.6 functional units (2x6.3 = 12.6), or could obtain an additional site such that the sum of the functional units for the two sites met or exceeded the total 12.6 points replacement requirement.

Functional Units can also be examined on a function-by-function basis to compare existing pre-project conditions with predicted post-project conditions. This concept is employed by the HGM method (Smith et al. 1995), and is illustrated by the following table, which assumes a two-acre impact to a 10-acre AA for hypothetical project.

There are several possible ways to determine mitigation needs using this approach, including:

- designing mitigation for individual functions or cumulatively for all functions using the **greatest** predicted loss in functional units as the replacement target (in this case, designing mitigation such that each function provides a minimum 5.2 functional units or designing the mitigation such that, cumulatively, 5.2 + 5.2 = 10.4 functional units are replaced); or

- designing mitigation for individual functions or cumulatively for all functions using the **average** predicted loss in functional units as the replacement target (in this case, designing mitigation such that each function provides a minimum 5 functional units [(4.8 + 5.2) / 2=5] or designing the mitigation such that, cumulatively, 5+5 = 10 functional units are replaced); or

- designing mitigation for individual functions or cumulatively for all functions using **individual** predicted changes in functional units as the target (in this case, 4.8 for function A and 5.2 for function B, or cumulatively using 4.8 + 5.2 = 10 functional units).

There may be circumstances that simply preclude the replacement of a given function/value parameter at the same level at which it is rated for an affected wetland. For example, if a project impacts a wetland rated "high" for Plant Community Composition due to its undisturbed hydrology and plant community, it is very unlikely that these could be mitigated at the same level at a replacement wetland because of the difficulty associated with replacement. In virtually all cases, appropriate mitigation of lost wetland functions and values will be subject to coordination/negotiation with the regulatory agencies involved in the project. It is not the purpose of this evaluation form to dictate wetland mitigation policy. What is and is not considered appropriate mitigation will ultimately be determined by the regulatory agencies; primarily the COE and EPA. While this evaluation method does provide a means for quantifying predicted impacts to wetland functions and values, it is important to stress that coordination with the regulatory agencies as to the application of this evaluation method and discussed mitigation determination strategies to a given project is crucial and needs to be carried out on a project by project basis.

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GLOSSARY OF TERMS

Background:
The distant part of the landscape surroundings, especially those behind something and providing harmony or contrast, > ½ mile from the viewer.

Deep Binding Rootmass:
Plants with extensive and deep root systems such as trees and shrubs, as well as sedges and rushes.

Entrenchment Ratio:
The ratio of the width of the flood prone area to the bank full surface of the channel.

Foreground:
The detailed landscape found within zero to ¼ - ½ mile from the observer.

Gradient:
The percent slope of the stream channel.

Groundwater Discharge:
Indicators of discharge include observed springs or seeps, vegetation growing during dormant or drought seasons, wetlands at the toe of a natural slope, permanent flooding during drought periods and presence of an outlet but no inlet.

Groundwater Recharge:
Indicators of recharge are difficult to discern in the field and include observation of a permeable substrate without an underlying impeding layer, or presence of an inlet but no outlet.

High Disturbance:
Land is heavily cultivated or heavily grazed, hayed or logged; subject to relatively substantial fill placement, grading, clearing or hydrological alteration, high road or building density.

Human Artifacts:
Objects made by humans, structures, fences, power lines, trash, etc.

Low Disturbance:
Land is managed in predominantly natural state; is not grazed, logged, cultivated or otherwise altered; does not contain roads or occupied buildings.

Middle ground:
The space between the foreground and the background in a landscape. The area located from ¼ - ½ mile from the viewer.

Moderate Disturbance:
Land is not cultivated but moderately grazed, hayed or selectively logged; or has been subject to minor clearing, fill placement or hydrological alteration; contains few roads or buildings.

Native Wetland Plants:
Vegetation that is considered to be native and categorized as an obligate wetland (OBL), facultative wetland (FACW), or facultative+ (FAC+) in the intermountain region (Region 8). Facultative (FAC), facultative- (FAC-), facultative upland (FACU), and obligate upland (UPL) species are not considered to be wetland plants.

Organic or Mineral Soils:

Soils are classified as organic if they are 20% or more organic carbon by weight. A soil is classified as an organic soil (Histosol) if more than half of the upper 80 cm (32 in) of the soil is organic or if the organic soil material of any thickness rests on rock or fragmental material having interstices filled with organic materials. In general, peat material needs to be 24 in. in depth to be considered an organic soil.

Permanent/Perennial:
Surface water is present throughout the year except during years of extreme drought.

Restricted Outlet:
A wetland with an outlet that is impeded by a dam, dike or water control structure.

Roadside Ditch Wetland:
For purposes of this UDOT functional assessment document a roadside ditch wetland is defined as follows: Any non-jurisdictional wetland <30 feet in width that exists in its entirety within the highway ROW, is an excavated upland and is not connected to any other jurisdictional wetland. Its primary source of hydrology is runoff from the road surface, irrigation overflow, irrigation ditch leakage or non-point surface runoff from an adjacent urbanized area. In addition, to qualify as a roadside ditch wetland the wetland of concern must **not** convey water to any adjacent natural stream, spring or natural or created wetland outside the ROW and must not contain any threatened or endangered species.

Salinity:
Containing sodium chloride or any of the salts of alkali metals or magnesium; measured as the amount of dissolved salts (ds) in solution measured as the electro conductivity of a water sample.

Seasonal/Intermittent:
Surface water is present for extended periods, especially early in the growing season, or may persist throughout the growing season, but may be absent at the end of the growing season; or surface water does not flow continuously, as when water losses from evaporation of seepage exceed the available stream flow.

Surface Roughness (High):
65% by aerial coverage of the AA contains surface roughness features. Surface roughness features include: emergent wetland, deep rooted woody and or herbaceous vegetation and for riverine and lacustrine wetlands may also include coarse woody debris, litter, boulders and micro-topography. (Adapted from Kleinschmidth Associates, 1999)

Surface Roughness (Moderate):
Between 35% and 65% by aerial coverage of the AA contains surface roughness features. (See above for surface roughness features) (Adapted from Kleinschmidth Associates, 1999)

Surface Roughness (Low):
<35% by aerial coverage of the AA contains surface roughness features. (See above for surface roughness features) (Adapted from Kleinschmidth Associates 1999)

Temporal/Ephemeral:
Surface water is present for brief period during the growing season, but the water table is well below the surface for most of the year; or surface water flows briefly in response to precipitation in the immediate vicinity and the channel is above the water table.

Threatened & Endangered Documented Habitat:
Federally listed or proposed threatened or endangered species have been documented at the AA by one or more credible sources, and the site is documented as critical habitat.

Threatened & Endangered Incidental Habitat:

Habitat that receives chance, inconsequential use by a given species or habitat conditions or the known distribution of the species would indicate this level of use. This term implies that, while it may be conceivable that a given species may occur at an AA at a given point in time, the chance is remote and the use is not likely to be repeated.

Threatened & Endangered Primary Habitat:
Habitat essential to the short or long-term viability of individuals or populations. The presence of traditional breeding, spawning, nesting, denning, or critical migratory habitat, large seasonal congregations (including communal roosts, staging habitat, traditional foraging congregations, etc.), or USFWS-designated critical habitat or core areas in the AA indicates primary habitat, as does any occurrence of a T&E plant.

Threatened & Endangered Secondary Habitat:
Habitat that is occasionally or semi-regularly used by a given species, but that is not necessarily essential to the short or long-term viability or individuals or populations. Examples would include non-specific migration areas and occasional forage or perch sites. Primary habitat, as defined above, may occur in the general vicinity (e.g., within the project area, section, drainage, watershed, etc.), but not in the AA.

Threatened & Endangered Suspected Habitat:
The physical and biological characteristics of the AA are similar to other wetlands in the ecoregion, where threatened or endangered species presence has been documented but presence has not been documented in the AA.

Unrestricted Outlet:
A wetland with an unimpeded outlet.

Urban/Exurban Wetland:
A wetland that exists within an urban or exurban context; hydrology is often altered by roads, buildings, parking, and other impervious surfaces; architectural elements are a predominant aspect of the visible landscape.

Viewshed:
The areas that include all that the observer can see from a particular location. Defining elements are frequently topography and vegetation. It is conceptually similar to a watershed.

Wetland Floodplain:
Wetlands within a floodplain.

Wildland Wetland:
A wetland that exists within a rural or wildland context; natural hydrological processes persist, rural or natural elements are a predominant aspect of the visible landscape

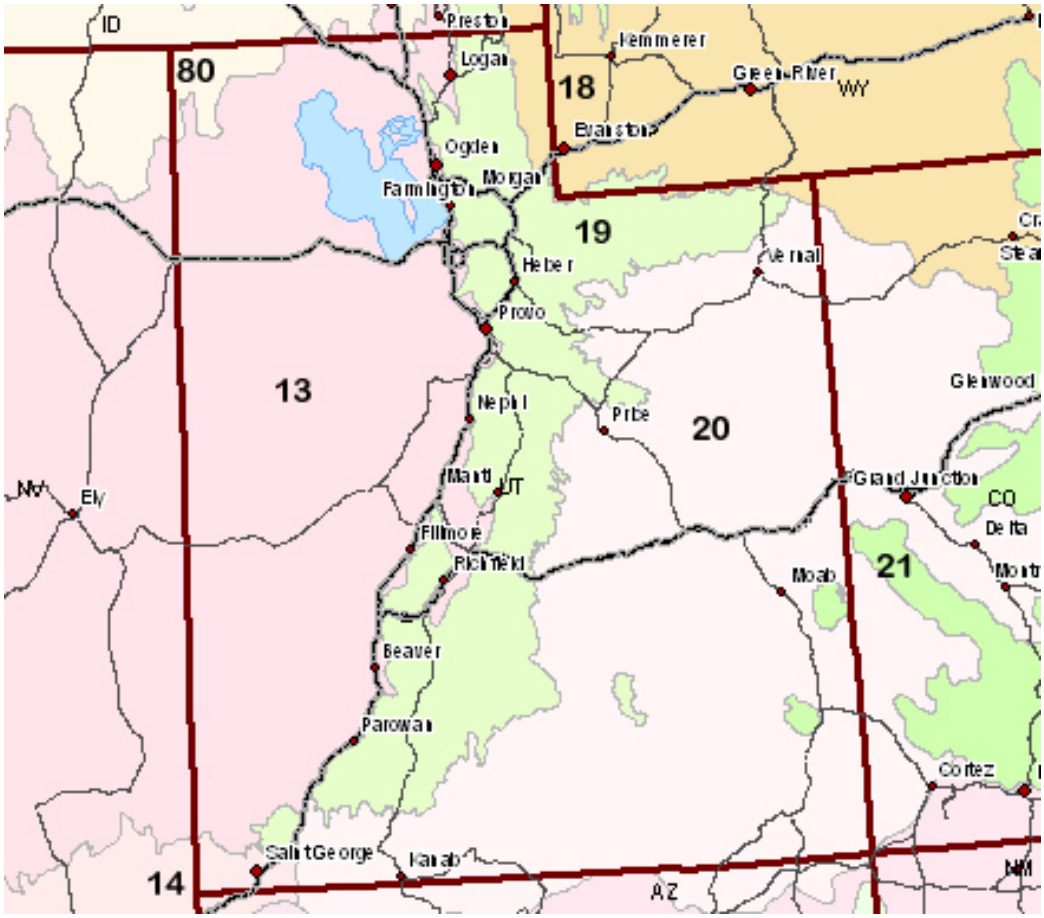
Width/Depth Ratio:
The ratio of bankfull channel width to bankfull mean depth.

APPENDIX A

Utah Ecoregion and Watershed Maps

Utah Ecoregion Map

Sources: http://www.nativeseednetwork.org/ecomap?state=UT
http://www.hort.purdue.edu/newcrop/cropmap/utah/maps/UTeco3.html
http://www.epa.gov/nheerl/arm/designing/design_eco_maps.htm



Ecoregion Descriptions

13. Central Basin and Range
The Central Basin and Range ecoregion is internally drained and is characterized by a mosaic of xeric basins, scattered low and high mountains, and salt flats. It has a hotter and drier climate, more shrubland, and more mountain ranges than the Snake River Plain and Northern Basin and Range ecoregions to the north. Basins are covered by Great Basin sagebrush or saltbush-greasewood vegetation that grow in Aridisols; cool season grasses are less common than in the Mollisols of the Snake River Plain and Northern Basin and Range. The region is not as hot as the Mojave and Sonoran Basin and Range ecoregions and it has a greater percent of land that is grazed.

14. Mojave Basin and Range
This ecoregion contains scattered mountains which are generally lower than those of the Central Basin and Range. Potential natural vegetation in this region is predominantly creosote bush, as compared to the mostly saltbush-greasewood and Great Basin sagebrush of the ecoregion to the north, and creosote bush-bur sage with large patches of palo verde-cactus shrub and saguaro cactus in the Sonoran Basin and Range to the south. Most of this region is federally owned and there is relatively little grazing activity because of the lack of water and forage for livestock. Heavy use of off-road vehicles and motorcycles in some areas has caused severe wind and water erosion problems.

18. Wyoming Basin
This ecoregion is a broad intermontane basin dominated by arid grasslands and shrublands and interrupted by high hills and low mountains. Nearly surrounded by forest covered mountains, the region is somewhat drier than the Northwestern Great Plains to the northeast and does not have the extensive cover of pinyon-juniper woodland found in the Colorado Plateaus to the south. Much of the region is used for livestock grazing, although many areas lack sufficient vegetation to support this activity. The region contains major producing natural gas and petroleum fields.

19. Wasatch and Uinta Mountains
This ecoregion is composed of a core area of high, precipitous mountains with narrow crests and valleys flanked in some areas by dissected plateaus and open high mountains. The elevational banding pattern of vegetation is similar to that of the Southern Rockies except that aspen, chaparral, and juniper-pinyon and oak are more common at middle elevations. This characteristic, along with a far lesser extent of lodgepole pine and greater use of the region for grazing livestock in the summer months, distinguish the Wasatch and Uinta Mountains ecoregion from the more northerly Middle Rockies.

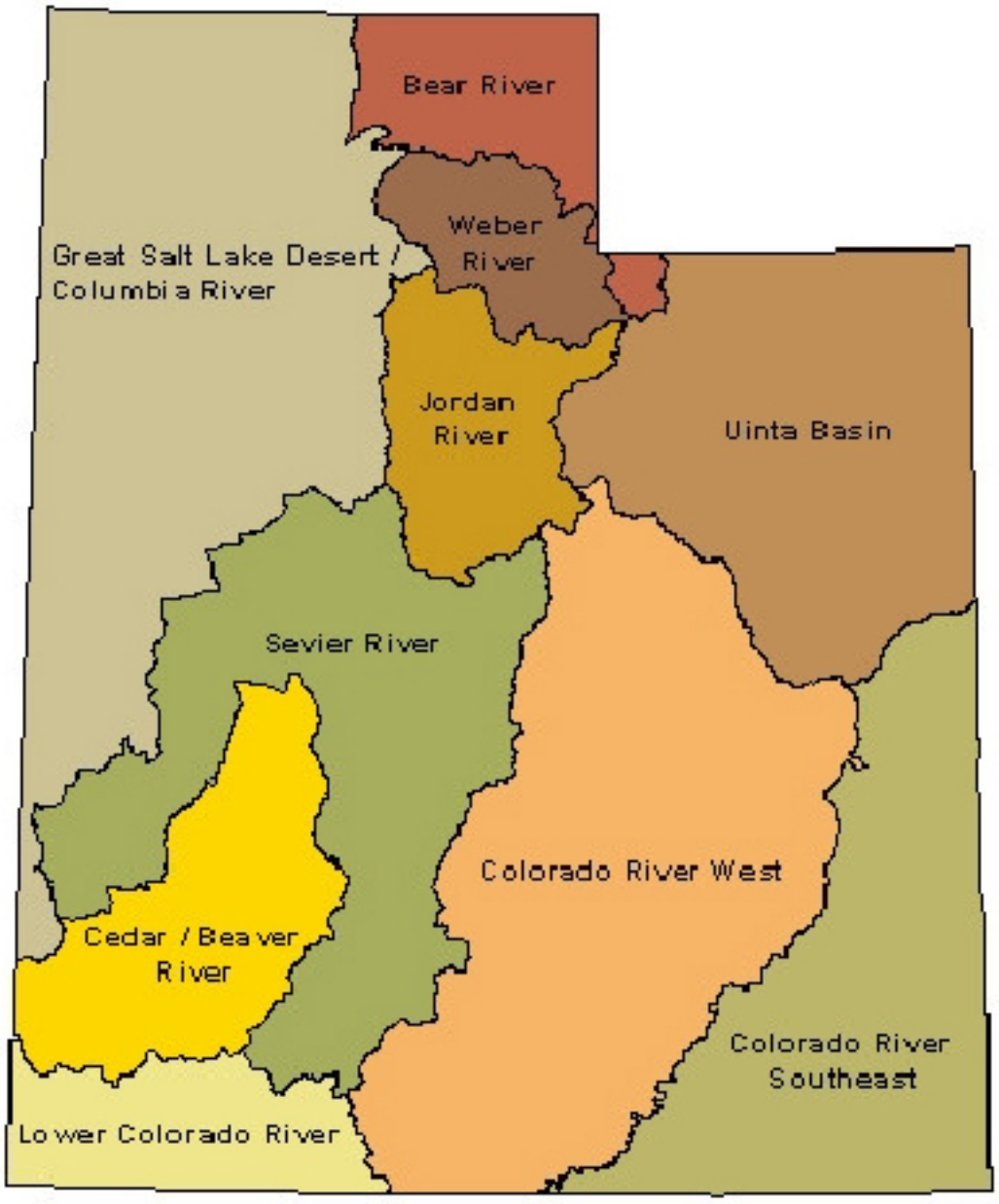
20. Colorado Plateaus
Rugged tableland topography is typical of the Colorado Plateau ecoregion. Precipitous side-walls mark abrupt changes in local relief, often from 300 to 600 meters. The region is more elevated than the Wyoming Basin to the north and therefore contains a far greater extent of pinyon-juniper woodlands. However, the region also has large low lying areas containing saltbrush-greasewood (typical of hotter drier areas), which are generally not found in the higher Arizona/New Mexico Plateau to the south where grasslands are common.

21. Southern Rockies
The Southern Rockies are composed of high elevation, steep rugged mountains. Although coniferous forests cover much of the region, as in most of the mountainous regions in the western United States, vegetation, as well as soil and land use, follows a pattern of elevational banding. The lowest elevations are generally grass or shrub covered and heavily grazed. Low to middle elevations are also grazed and covered by a variety of vegetation types including Douglas fir, ponderosa pine, aspen, and juniper oak woodlands. Middle to high elevations are largely covered by coniferous forests and have little grazing activity. The highest elevations have alpine characteristics.

80. Northern Basin and Range
This ecoregion contains arid tablelands, intermontane basins, dissected lava plains, and scattered mountains. Non-mountain areas have sagebrush steppe vegetation; cool season grasses and Mollisols are more common than in the hotter-drier basins of the Central Basin and Range where Aridisols are dominated by sagebrush, shadscale, and greasewood. Ranges are generally covered in Mountain sagebrush, mountain brush, and Idaho fescue at lower and mid-elevations; Douglas-fir, and aspen are common at higher elevations. Overall, the ecoregion is drier and less suitable for agriculture than the Columbia Plateau and higher and cooler than the Snake River Plain. Rangeland is common and dryland and irrigated agriculture occur in eastern basins.

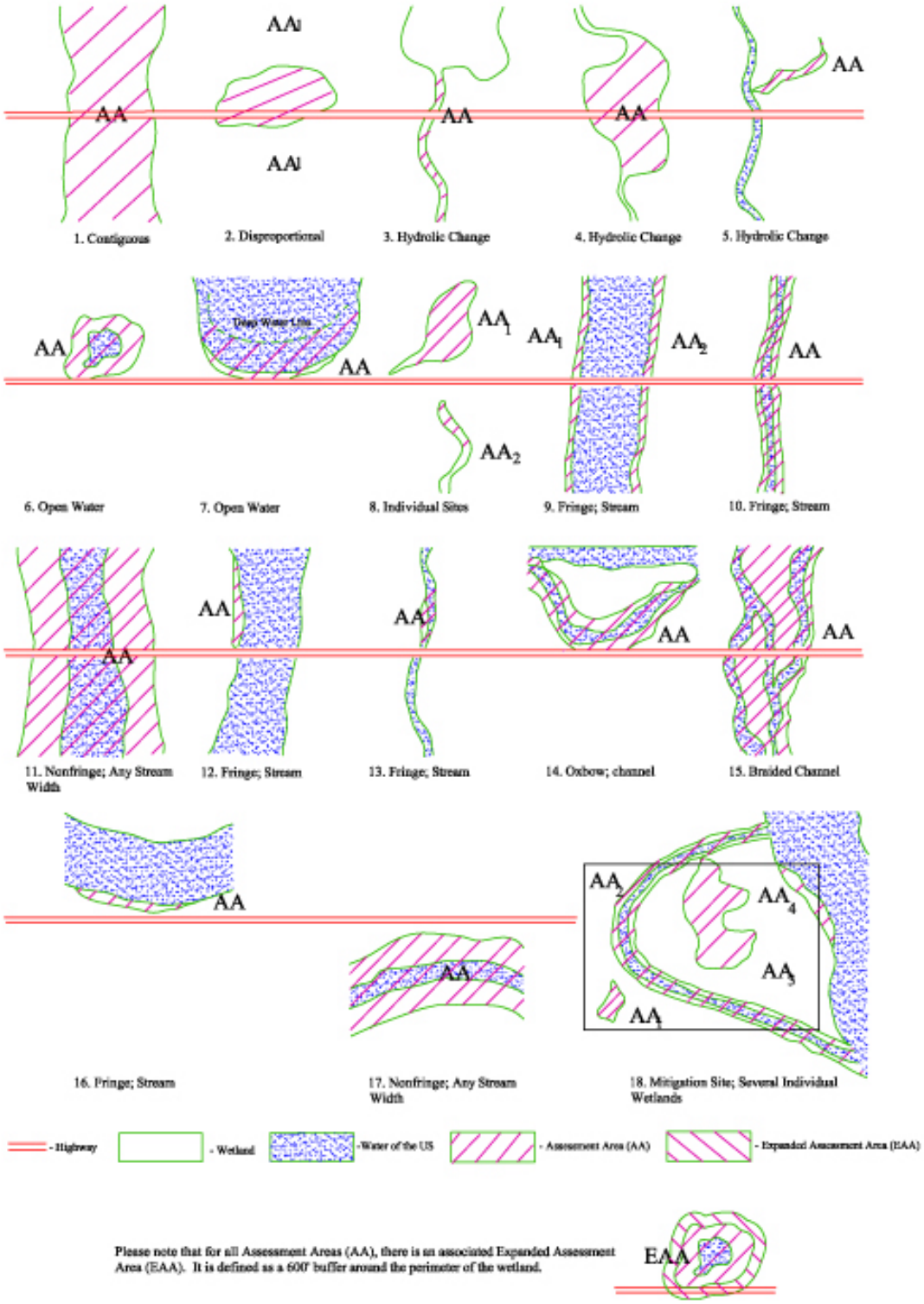
Utah Watershed Map

From http://waterquality.utah.gov/watersheds/state.htm



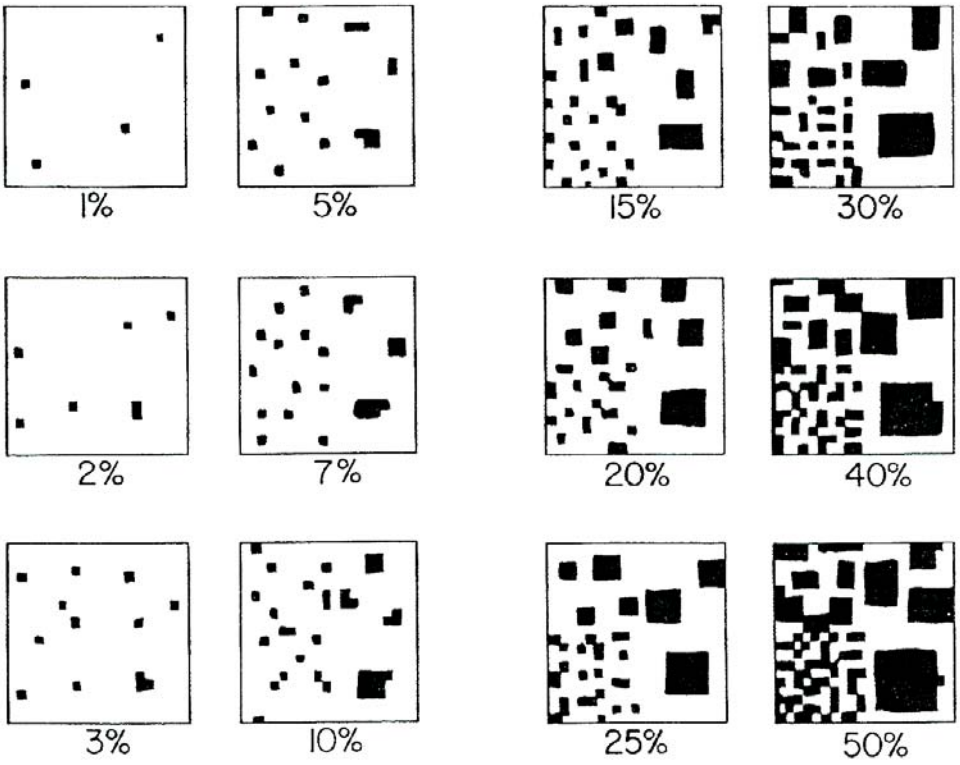
APPENDIX B

Sample Assessment Area (AA) Diagrams


AA
AA
AA
1. Contiguous
AA
AA
2. Disproportional
AA
3. Hydrologic Change
AA
4. Hydrologic Change
AA
5. Hydrologic Change
AA
Deep Water Line
AA
6. Open Water
7. Open Water
AA1
AA2
8. Individual Sites
AA1
AA2
9. Fringe; Stream
AA
10. Fringe; Stream
AA
AA
11. Nonfringe; Any Stream Width
AA
12. Fringe; Stream
AA
13. Fringe; Stream
AA
14. Oxbow; channel
AA
15. Braided Channel
AA
16. Fringe; Stream
AA
17. Nonfringe; Any Stream Width
AA2
AA4
AA3
AA1
18. Mitigation Site; Several Individual Wetlands
- Highway
- Wetland
- Water of the US
- Assessment Area (AA)
- Expanded Assessment Area (EAA)
Please note that for all Assessment Areas (AA), there is an associated Expanded Assessment Area (EAA). It is defined as a 600' buffer around the perimeter of the wetland.
EAA

APPENDIX C

Guidelines for Estimating %Coverage or %Canopy Closure



Note: To Estimate percentages >50% use white portions instead of black. (e.g., to get an idea of what 75% looks like, look at 25% and use the white instead of the black). Each fourth of any one square has the same amount of black. Source: Munsell Soil Charts (1994, revised edition).

APPENDIX D

Great Basin Depressional and Slope Wetland Profiles by Subclass

Introduction

The wetland profiles described in this booklet are based on HGM subclasses. The state is divided into three major Ecoregions – Great Basin (13), Rocky Mountain (19), and Colorado Plateau (20).

[The term "Great Basin" refers to all four Ecoregions that this appendix applies to – Central Basin and Range (13), Mojave Basin and Range (14), Wyoming Basin (18), and Northern Basin and Range (80).]

EPA Level III Ecoregions

The subclasses in the Great Basin are driven by the salinity of the water and the water regime (determined through principal components factor analysis of reference standard sites in the entire class). The salinity is based on electrical conductivity and given in dS.

The classes of salinity are as follows:

1 Low salinity < 7.5 dS
2 Moderate salinity ≥7.5 and <22.5 dS
3 High salinity / hypersaline ≥ 22.5 dS

Water regime classes for depressions are as follows:

0 Ephemeral – surface water is present in some years for brief periods (<3 months)
1 Seasonal – surface water is present in most years for 3-6 months
2 Semi permanent – surface water is common to persistent in most years for 6-12 months
3 Permanent – surface water is continuously present in all years.

Water regime classes for slopes are as follows:

1 Seasonal slope - Average depth to water table > 20 inches
2 Persistent slope - Average depth to water table ≤ 20 inches

Hydrogeomorphic Depression and Slope Wetland Class Descriptions

Depressional wetlands are topographic depressions with closed contours. Water sources are precipitation, runoff and/or groundwater. Water flow vectors are toward the center of the depression. The dominant hydrodynamics are vertical. They may or may not have inlets and outlets.

Slope wetlands occur at points of surface changes, breaks in slope or stratigraphic changes. Groundwater and runoff are the primary water sources. Water flow is unidirectional (down slope/ gradient). Water may discharge to a stream, lake or depression.

[Mineral flat wetlands occur on large relict lakebeds. Dominant water source is precipitation and dominant hydrodynamics are vertical. (Great Salt Lake mudflats and salt flats)]

Great Basin Ecoregion

The ecoregion is made up of north-south trending, fault block mountain ranges whose bases are buried in their own alluvium. Valley bottoms often contain salt pans, salt flats or fresh to saline lakes and ponds. The slopes directly above the pans are complexes of alluvial fans. Valleys on the east sides of the mountains tend to fall less steeply and are generally longer than those on the west sides. There are few perennial streams (all drain internally) and there are many small springs. Large lakes and marshes occur in the valley bottoms and may be fresh or saline. The natural vegetation from low to higher elevations is saltbrush-greasewood, Great Basin sagebrush, pinyon-juniper woodland and western spruce-fir forest.

The average annual precipitation ranges from about 12 inches in the lower valleys to more than 30 inches at higher elevations. Average annual temperature is in the low 50's in the valleys and low 40's in the mountains. Summers are usually hot and dry. Most of the summer precipitation is the result of thunderstorms that build up over the mountains. Precipitation is light during the summer and early fall. It reaches a maximum in the spring when storms moving in from the Pacific are most intense. About one third of the precipitation falls as snow during the period between December and March.

Soils in the region range from mesic Aridisols at low elevations to frigid Mollisols at higher elevations. Entisols occur on fans, floodplains and in valley bottoms. Basin soils are often saline and alkaline.

Seasonal or Semi Permanent Depressions - hypersaline (EC > 22.5 dS)

(These sites may be moderately saline (7.5 – 22.5 dS) at other times of the year)

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species* in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics hypersaline reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,202	4,520	4,284.56	134.03
Native species	1.00	1.00	1.00	0.00
Indicator species*	0.80	0.96	0.88	0.05
Vegetation cover	0.21	0.35	0.27	0.06
TDS water ppm	13,800.00	341,980.00	73,000.00	106,970.60
TSS water mg/L	202.00	365.00	243.00	70.58
EC water dS	24.10	100.00	49.53	23.21
Water pH	7.00	8.30	7.61	0.37
Nitrate-N water mg/L	0.11	0.22	0.18	0.04
Phosphates water mg/L	0.03	0.12	0.07	0.04
NP ratio water	1.42	4.00	3.15	1.19
Silica water mg/L	6.32	21.02	14.94	6.51
Cadmium water mg/L	0.02	0.02	0.02	0.00
Lead water mg/L	0.03	0.06	0.04	0.02
Soil pH	7.68	7.82	7.73	0.05
Soil EC dS	14.10	440.00	131.79	127.59
Soil organic carbon %	2.92	8.63	5.87	2.34
Soil total nitrogen %	0.03	0.29	0.11	0.09
Soil CN ratio	11.55	287.67	114.46	107.50
Cadmium mg/kg	0.05	0.10	0.08	0.03
Lead mg/kg	0.16	1.81	0.84	0.81

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .26 and it makes up an average of 84% of the total vegetative cover

2nd dominant – *Salicornia utahensis* (Utah samphire) or more often, *Salicornia europaea* (annual samphire) are the second dominant in all reference sites with average cover of .03

3rd dominant - *Triglochin maritima* (maritime arrowgrass) or *Cordylanthus maritimus* (alkali birdsbeak) with average cover of .01 *Scirpus maritimus* (alkali bulrush) at .01 with some disturbance

4th dominant – *Suaeda depressa* (broom seepweed), *Triglochin palustris* (marsh arrowgrass) with average cover of .01

5th dominant – *Sporobolus airoides* (alkali saccaton) and *Triglochin maritima* (maritime arrowgrass) with average cover of .01

Vegetation species richness

Average species richness is 4 (range 1-5), often including -*Distichlis stricta* (desert salt grass), *Salicornia europaea* (annual samphire) and *Triglochin maritima* (maritime arrowgrass). Species richness tends to increase with disturbance, with average species richness increasing to between 6 and 7 species.

Typical invasive species
Hordeum jubatum (foxtail barley)*, Phragmites australis* (common reed)*, Kochia scoparia* (summer cypress)

Plant list for reference standard sites
Distichlis stricta (desert salt grass)
Salicornia europea / utahensis (annual and Utah samphire)
Triglochin maritima / palustris (maritime and marsh arrowgrass)
Cordylanthus maritimus (alkali birdsbeak)
Scirpus maritimus (alkali bulrush)
Suaeda depressa (broom seepweed)
Sporobolus airoides (alkali saccaton)

Sites surveyed are located in Box Elder, Salt Lake, Tooele and Utah Counties. All sites in Salt Lake and Tooele Counties are below 4217 feet.

Site location and vegetation scores

Sites	Easting	Northing	Reference	VIBI	Richness
goshenplaya1	12424531	4422782	1.00	1.00	5.00
goshenplaya3	12424531	4422782	1.00	1.00	5.00
saltwellsplaya1	12356517	4619352	1.00	1.00	5.00
saltwellsplaya2	12356517	4619352	1.00	1.00	5.00
saltwellsplaya3	12356517	4619352	1.00	1.00	5.00
goshensalt4	12422972	4428245	1.00	1.00	1.00
bluelakeplaya2	11751222	4487832	.93	.86	7.00
plover	12367854	4508863	.93	1.00	2.00
plover2	12367847	4508875	.93	1.00	3.00
limestone1	12364323	4509462	.93	1.00	3.00
limestone2	12364323	4509462	.93	.73	6.00
southpond1	12406732	4515154	.75	.76	7.00
northpond	12404703	4517581	.75	.51	7.00
saltwellspond1	12356483	4619286	.75	.83	6.00

Plover Playa, Tooele County

Salt Wells Playa, Box Elder County

Goshen Playa, Utah County

Seasonal Depressions - moderately saline (7.5 – 22.5 dS)

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics seasonal moderately saline reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Species richness	5.00	11.00	7.17	2.04
Elevation ft	4,217	4,520	7.17	116.95
Native species	1.00	1.00	1.00	0.00
Indicator species	0.80	0.96	0.91	0.07
Vegetation cover	0.33	0.44	0.36	0.04
TDS water ppm	5,400.00	7,926.00	6,849.33	852.17
TSS water mg/L	25.00	83.00	50.33	29.69
EC water dS	9.00	13.20	10.98	1.58
water pH	8.50	9.80	9.09	0.54
Nitrate-N water mg/L	0.05	0.16	0.09	0.06
Phosphate water mg/L	0.01	0.02	0.01	0.00
NP ratio water	5.00	16.00	7.80	4.76
Silica water mg/L	0.56	11.86	5.07	5.05
Cadmium water mg/L	0.02	0.02	0.02	
Lead water mg/L	0.03	0.06	0.06	
Soil pH	7.60	8.87	8.07	0.53
Soil EC dS	29.00	590.00	160.67	214.12
Soil organic carbon %	2.92	12.20	6.62	3.83
Soil total nitrogen %	0.01	0.19	0.10	0.07
Soil CN ratio	17.18	356.00	129.76	123.70
Cadmium mg/kg	0.05	0.10	0.06	0.03
Lead mg/kg	0.15	7.21	3.43	2.98

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .28.

2nd / 3rd dominant – Salicornia *utahensis* (Utah samphire)(average cover .01) in 67% of sites, *Scirpus maritimus* (alkali bulrush) (average cover .02) in 83% of sites or *Salicornia europaea* (annual samphire) (average cover .05) in 33 % of sites.

4th and 5th dominant – *Triglochin spp* (arrowgrass) (average cover .01) in 50% of sites, *Allenrolfea occidentalis* (iodine bush) (average cover .01) in 16 %, *Sarcobatus vermiculatus* (greasewood) (average cover .01) in 16% of sites.

Other species occurring

Puccinellia nuttalliana (Nuttall's alkaligrass), *Scirpus acutus* (hardstem bulrush) and *S. americanus* (Olney's threesquare)

Nonnative/ invasive species

Hordeum jubatum (foxtail barley), *Polypogon monspeliensis* (rabbitfoot grass)

Vegetation species richness
Species richness of plants in reference sites averages 7 species, ranging from 5-7. In disturbed sites, it falls to 3 and climbs as high as 11.

Plant list for references standard sites
Distichlis stricta (desert salt grass)
Salicornia europea / utahensis (annual and Utah samphire)
Scirpus maritimus (alkali bulrush)
Triglochin maritime / palustris (maritime and marsh arrowgrass)
Allenrolfea occidentalis (iodine bush)
Scirpus acutus (hardstem bulrush)
Sarcobatus vermiculatus *(greasewood)*
Puccinellia nuttalliana (Nuttall's alkaligrass)
Suaeda depressa (broom seepweed)

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
bluelakeplay1	11751222	4487832	0.93	1.00	7.00
bluelakeplay3	11751222	4487832	0.93	1.00	7.00
bluelakeplay4	11751222	4487832	0.93	1.00	7.00
goshenplay2	12424531	4422782	1.00	1.00	5.00
duckplaya2	12391395	4604369	0.92	1.00	6.00
migrate1	12343716	4617473	0.91	0.90	10.00
migrate2	12343716	4617473	0.91	0.90	10.00
migrate3	12343716	4617473	0.91	0.90	10.00
airport22	12411865	4519420	0.83	0.76	8.00
airport23	12411865	4519420	0.83	0.76	5.00
airport30	12411810	4519614	0.83	0.88	4.00
airport32	12411810	4519614	0.83	0.95	5.00
airport33	12411810	4519614	0.83	0.88	4.00
airport34	12411810	4519614	0.83	0.88	4.00
airport20	12411865	4519420	0.83	0.68	8.00
amalgabarrn	12422773	4634164	0.75	0.72	3.00
airport21	12411865	4519420	0.83	0.51	7.00

Salt Lake Airport, Salt Lake County

Semi permanent and permanent depressions - Moderately saline (7.5 – 22.5 dS)

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics semi-permanent and permanent moderately saline reference standard sites	Minimum	Maximum	Mean	Std. Deviation
Species richness	1.00	7.00	4.45	2.54
Elevation ft	4,220	4,500	4,319.00	118.38
Native species	1.00	1.00	1.00	0.00
Indicator species	0.80	0.92	0.87	0.05
Vegetation cover	0.56	0.79	0.69	0.09
TDS water ppm	6,960.00	11,520.00	9,197.45	1,885.23
TSS water mg/L	18.00	22.30	20.15	3.04
Water EC dS	10.10	20.10	15.08	3.55
Water pH	7.50	8.90	8.04	0.56
Nitrate-N water mg/L	0.03	0.21	0.09	0.08
Phosphate water mg/L	0.01	0.05	0.02	0.02
NP ratio water	1.00	21.00	7.50	9.15
Silica water mg/L	5.47	16.80	11.64	4.29
Cadmium water mg/L	0.02	0.02	0.02	0.00
Lead water mg/L	0.03	0.20	0.10	0.08
Soil pH	7.40	8.10	7.84	0.26
Soil EC dS	8.60	140.00	51.27	48.89
Soil organic carbon %	1.28	12.80	6.09	3.60
Soil total nitrogen %	0.08	0.57	0.21	0.14
Soil CN ratio	12.13	67.37	33.96	22.10
Cadmium mg/kg	0.02	0.10	0.05	0.02
Lead mg/kg	0.44	5.22	2.40	1.79

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) is always the first dominant in reference sites with average cover of .56.

2nd / 3rd dominant – *Salicornia utahensis* (Utah samphire) (average cover .02) in 18 % of sites*, Scirpus americanus* (Olney's threesquare) (average cover .07) in 73% of sites, *Juncus arcticus* (wiregrass) (average cover .11) in 18% or *Eleocharis palustris* (common spikerush) (average cover .07) in 27 % of sites.

4th and 5thdominant – *Triglochin spp* (arrowgrass) (average cover .01) in 27% of sites*, Sporobolus airoides* (alkali saccaton) (average cover .02) in 27% of sites and *Cordylanthus maritimus* (alkali birdsbeak) (average cover .01) in 18% of sites

Other species occurring

Puccinellia nuttalliana (Nuttall's alkaligrass)*, Allenrolfea occidentalis* (iodine bush)*, Suaeda depressa* (broom seepweed)

Nonnative/invasive species

Bromus tectorum (cheatgrass)*, Hordeum jubatum* (foxtail barley) *and glaucum/murinum* (rabbit barley)*, Phragmites australis* (common reed)

Vegetation species richness

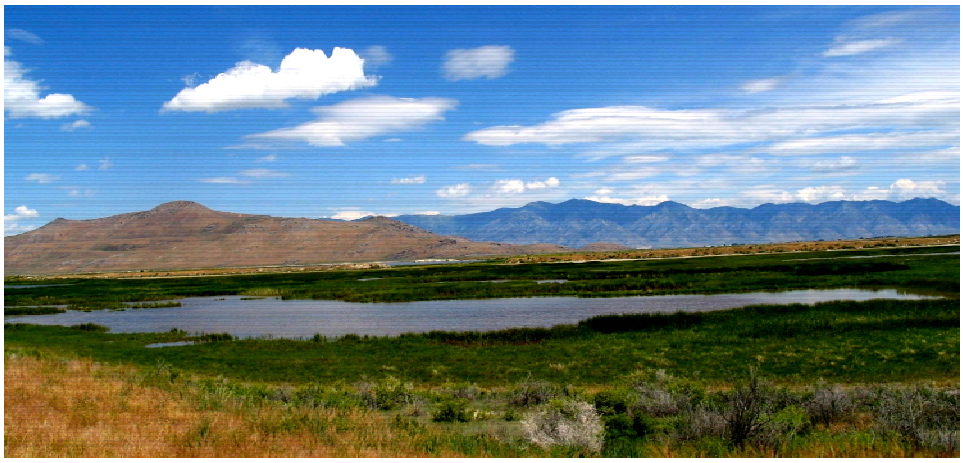
In reference sites, average is 4 species, ranging from 1-7. In disturbed sites, it climbs as high as 11.

Plants list for reference sites
Distichlis stricta (desert salt grass)
Scirpus americanus (Olney's threesquare)
Juncus arcticus/ balticus (wiregrass)
Eleocharis palustris (common spikerush)
Salicornia utahensis (Utah samphire)
Triglochin maritima/ palustris (maritime and marsh arrowgrass)
Sporobolus airoides (alkali saccaton)
Cordylanthus maritimus (alkali birdsbeak)
Scirpus acutus (hardstem bulrush)
Scirpus maritimus (alkali bulrush) *Allenrolfea occidentalis* (iodine bush)
Suaeda depressa (broom seepweed)
Puccinellia nuttalliana (Nuttall's alkaligrass)

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
bluelakepond1	11750755	4487823	1.00	1.00	5.00
horseshoe2	12355359	4497291	0.92	0.47	9.00
bluelakespring2	11750368	4487395	1.00	1.00	7.00
saltwellsm1	12356059	4621998	1.00	1.00	3.00
southhull	12391552	4602077	0.92	0.85	10.00
bullrush	12366021	4507953	0.83	1.00	4.00
cement	12366922	4507159	0.92	1.00	4.00
goshenssalt2	12423251	4427893	1.00	1.00	1.00
goshenssalt1	12423251	4427893	1.00	1.00	1.00
bluelakepond 2	11750755	4487823	1.00	1.00	8.00
bluelakespringu	11750368	4487395	1.00	1.00	7.00
horseshoe 1	12355359	4497291	0.92	0.61	8.00
lowerwest1	12405269	4516670	0.75	0.62	7.00
lowerwest2	12405269	4516670	0.75	0.59	6.00
bluelakepond3	11750779	4487646	1.00	1.00	7.00
lowerwest3	12405269	4516670	0.75	0.50	6.00
saltwellsm 2	12356059	4621998	1.00	1.00	2.00
saltwellsm 3	12356059	4621998	1.00	1.00	4.00
goshensalt3	12423251	4427893	1.00	1.00	1.00
goggin1	12405792	4518993	0.75	0.47	3.00
goggin2	12405792	4518993	0.75	0.68	4.00

South of Goshen, Utah County



South of Hull Lake, Public Shooting Grounds, Box Elder County

Pond in Blue Lake Complex, Tooele County

Seasonal, semi permanent and permanent depressions – freshwater (EC≤ 7.5 dS)

Note: There are virtually no natural, unimpacted sites in this subclass. All natural sites are impacted to some degree and all other sites are created or 'enhanced'/impounded management areas.

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Seasonal freshwater depressions

Among the seasonal sites, water quality is least impacted at Duck Lake, Public Shooting Grounds, although lead is elevated (.06), with the average being .02-.03 mg/L. Duck Lake scores a 1.00 for it's vegetation IBI.

Water chemistry Duck Lake	
TDS ppm	4792
TSS mg/L	43
EC dS	6.90
PH	8.90
Nitrate-N mg/L	.05
Phosphates mg/L	.04
NP ratio	1.39
Silica mg/L	5.86
Lead mg/L	.06
Cadmium mg/L	.02

Descriptive Statistics freshwater seasonal reference standard sites

	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,205	4,221	4,213.00	11.31
Native species	0.80	1.00	0.90	0.14
Indicator species	0.80	0.92	0.86	0.08
Vegetation cover	0.46	0.50	0.48	0.03
TDS water ppm	3,420.00	4,792.00	4,106.00	970.15
TSS water mg/L	43.00	67.50	55.25	17.32
Water EC dS	5.70	6.90	6.30	0.85
Water pH	8.30	8.90	8.60	0.42
Nitrate-N water mg/L	0.05	0.65	0.35	0.42
Phosphate water mg/L	0.03	0.04	0.03	0.00
NP ratio water	1.39	21.67	11.53	14.34
Silica water mg/L	5.86	14.32	10.09	5.98
Lead water mg/L	0.05	0.06	0.06	0.01
Cadmium water mg/L	0.02	0.02	0.02	0.00
Soil pH	8.52	8.61	8.57	0.06
Soil EC dS	2.00	99.00	50.50	68.59
Soil organic carbon %	3.41	3.49	3.45	0.06
Soil total nitrogen %	0.04	0.10	0.07	0.04
Soil CN ratio	34.10	87.25	60.68	37.58
Cadmium soil mg/kg	0.05	0.10	0.08	0.04
Lead soil mg/kg	7.21	10.80	9.01	2.54

Dominant species
1st dominant **-** *Distichlis stricta* (desert salt grass) (average cover .22) in all reference sites
2nd dominant **-** *Scirpus americanus* (Olney's threesquare) and/or *Scirpus maritimus* (alkali bulrush) (average cover .11) in all reference sites
3rd dominant **-** *Salicornia europaea* (annual samphire) in all reference sites (cover .06)
4th / 5th dominant - In 50 % of sites *Sarcobatus vermiculatus*(greasewood) and/or *Allenrolfea occidentalis* (iodine bush) (cver .01)

Species occasionally occurring
Puccinellia nuttalliana (Nuttall's alkaligrass) *Poa palustris* (fowl bluegrass)

Common nonnative and invasive species
Polypogon monspeliensis (rabbitfoot grass)*, Hordeum jubatum* (foxtail barley)*, Phragmites australis* (common reed)*, Typha spp* (cattail)*, Agrostis stolonifera* (redtop bentgrass)

Vegetation species richness
In reference standard sites average species richness is 6. In disturbed sites it climbs as high as 15 species. In general, disturbance increases the species diversity.

Plants list for reference standard sites
Distichlis stricta (desert salt grass)
Scirpus americanus (Olney's threesquare)
Scirpus acutus (hardstem bulrush)
Scirpus maritimus (alkali bulrush)
Eleocharis palustris (common spikerush)
Alisma plantago-aquatica (water plantain)
Salicornia europaea (annual samphire)
Salicornia utahensis (Utah samphire)
*Poa palustris (fowl bluegrass)**
Juncus arcticus (wiregrass)
Allenrolfea occidentalis (iodine bush)
Carex praegracilis (blackcreeper or clustered field sedge)
Carex nebrascensis (Nebraska sedge)
Carex spp.
Iris missouriensis ***** (Missouri iris)
Nitrophila occidentalis (western boraxweed or niterwort)
Elymus triticoides (beardless or creeping wild rye)
Potamogeton species (pondweed)
Agropyron trachycaulum (slender wheatgrass)
Potentilla anserina (common silverweed)
Senecio hydrophilus (water groundsel)
Solidago missouriensis (goldenrod)
Sarcobatus vermiculatus (greasewood)
Ranunculus spp. (buttercup)
Sagitteria cuneata (arrowleaf)
Sueada depressa (seepweed)
Mentha arvensis (field mint)
Aster chilensis (common California daisy)
Asceplias speciosa (showy milkweed)

Semi-permanent and permanent depressions - freshwater

Note: Among the semi-permanent and permanent sites, water quality is least impacted at Fish Springs. It does not, however, score well on the vegetation IBI and zebra snails were collected from the site.

Water chemistry Fish Springs	
TDS ppm	348
TSS mg/L	6.50
EC dS	5.80
pH	7.70
Nitrate-N mg/L	.12
Phosphates mg/L.	01
NP ratio	12.00
Silica mg/L	9.52
Lead mg/L	.03
Cadmium mg/L	.02

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Descriptive Statistics freshwater semi- permanent and permanent reference standard sites				
	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,204	4,784	4,441.33	280.78
Native species	0.80	1.00	0.87	0.10
Indicator species	0.92	1.00	0.95	0.03
Vegetation cover	0.62	0.84	0.76	0.09
TDS water ppm	480.00	3,420.00	1,374.67	1,135.75
TSS water mg/L	17.50	169.00	60.60	63.77
EC water dS	0.80	5.70	2.19	1.85
pH water	7.60	9.40	8.47	0.76
Nitrate-N water mg/L	0.04	0.65	0.26	0.27
Phosphates water mg/L	0.02	0.70	0.15	0.27
NP ratio water	0.17	27.50	9.65	11.98
Silica water mg/L	6.22	24.48	13.38	6.91
Lead water mg/L	0.03	0.03	0.03	0.00
Cadmium water mg/L	0.02	0.02	0.02	0.00
Soil pH	7.07	8.52	7.81	0.55
Soil EC dS	1.50	5.40	2.38	1.50
Soil organic carbon %	3.41	11.40	7.35	3.61
Soil Total nitrogen %	0.10	1.02	0.62	0.39
Soil CN ratio	9.27	34.10	15.68	9.48
Cadmium mg/kg	0.02	0.14	0.07	0.05
Lead mg/kg	0.46	25.26	7.99	9.53

Dominant species

1st dominant **-** *Eleocharis palustris* (common spikerush) (average cover .29) in 75% reference sites

2nd dominant **-** *Scirpus spp***.,** usually *Scirpus americanus* (Olney's threesquare) (average cover .23) in all reference sites

3rd dominant - *Juncus arcticus* (wiregrass) in 75% reference sites (average cover .09)

4th / 5th dominant - In 50 % of sites *Distichlis stricta* (desert salt grass) (average cover .14)

Species occasionally occurring
Alisma plantago-aquatica (water plantain), *Potamogeton* spp. (pondweed), *Carex praegracilis* (blackcreeper or clustered field sedge), *Iris missouriensis* (Missouri iris), *Asclepias speciosa* (showy milkweed)

Common nonnative and invasive species
Polypogon monspeliensis (rabbitfoot grass), *Hordeum jubatum* (foxtail barley), *Phragmites australis* (common reed), *Typha spp*(cattail), *Rumex crispus* (curley dock), *Nasturtium officinale* (watercress), *Trifolium repens* (white clover), *Lythrum salicaria*** (purple loosestrife)

Vegetation species richness
In reference standard sites average species richness is 11-12. In disturbed sites it climbs as high as 22-23 or drops as low as 5 species.

Plants list for reference standard sites
Distichlis stricta (desert salt grass)
Scirpus americanus (Olney's threesquare)
Scirpus acutus (hardstem bulrush)
Scirpus maritimus (alkali bulrush)
Eleocharis palustris (common spikerush)
Alisma plantago-aquatica *(water plantain)*
Salicornia europaea (annual samphire)
Salicornia utahensis (Utah samphire)
Poa palustris *(fowl bluegrass)*
Juncus arcticus (wiregrass)
Allenrolfea occidentalis (iodine bush)
Carex praegracilis (blackcreeper or clustered field sedge)
Carex nebrascensis (Nebraska sedge)
Carex spp.
Iris missouriensis (Missouri iris)
Nitrophila occidentalis (western boraxweed or niterwort)
Elymus triticoides (beardless or creeping wild rye)
Potamogeton species (pondweed)
Agropyron trachycaulum (slender wheatgrass)
Potentilla anserina (common silverweed)
Senecio hydrophilus (water groundsel)
Solidago missouriensis (goldenrod)
Sarcobatus vermiculatus (greasewood)
Ranunculus spp. (buttercup)
Sagitteria cuneata (arrowleaf)
Sueada depressa (seepweed)
Mentha arvensis (field mint)
Aster chilensis (common California daisy)
Asceplias speciosa (showy milkweed)
** at one site in the semi-permanent / permanent sites , we found exotic zebra snails which are a vector for a fish killing disease and are reported from another site in this group of surveyed sites
** at one seasonal site – found New Zealand mud snails

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI	Richness
kayscreekpond	12414754	4541873	0.90	0.61	14.00
towerpond	12413714	4543006	0.95	0.78	8.00
airport24	12411865	4519420	0.83	0.60	5.00
duckplaya	12391505	4604408	0.97	1.00	6.00
lelandharrislow	12251791	4382891	0.93	1.00	11.00
2impoundfbwma2	12423882	4531348	0.85	0.49	7.00
davispond2	12423276	4534161	0.90	0.59	7.00
lelandharrisup	12251791	4382891	0.93	0.79	22.00
davispond	12423291	4533882	0.90	0.40	10.00
2impoundfbwma	12423882	4531348	0.85	0.40	5.00
airportpond	12411607	4518726	0.58	0.51	12.00
nolaneplaya	12422670	4624969	0.90	0.76	7.00
nolaneplaya2	12422670	4624969	0.90	0.59	7.00
loosestrife	12421789	4523685	0.33	0.20	25.00
upperwestpond2	12405451	4516624	0.75	0.39	8.00
upperwestpond	12405451	4516624	0.75	0.39	8.00
dumppond	12422453	4528844	0.58	0.31	14.00
bearriverbottoms1	12424787	4641273	0.92	0.63	12.00
tncpond	12410229	4544016	0.83	0.66	7.00
bearriverbottoms2	12424787	4641273	0.92	0.63	12.00
fishspring1	12293681	4418044	0.87	0.69	12.00

Duck Playa – Public Shooting Grounds

Leland Harris Complex, Juab County

TNC Layton Marsh, Davis County

Ephemeral depressions

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site

Descriptive Statistics ephemeral reference standard sites	Minimum	Maximum	Mean	Std. Deviation
Elevation ft	4,205	4,210	4,206.67	2.89
Native species	0.67	1.00	0.89	0.19
Indicator	0.67	1.00	0.89	0.19
Cover	0.05	0.29	0.21	0.14
TDS water ppm	10,100.00	26,400.00	18,250.00	11,525.84
Water EC dS	17.70	46.50	32.10	20.36
Water pH	7.90	7.90	7.90	0.00
Soil pH	8.20	8.30	8.23	0.06
Soil EC dS	93.00	103.00	99.67	5.77
Soil organic carbon %	0.56	1.30	0.81	0.43
Soil total nitrogen %	0.06	0.07	0.06	0.01
Soil CN ratio	9.33	19.00	12.56	5.58
Cadmium soil mg/kg	0.09	0.09	0.09	.
Lead soil mg/kg	15.50	15.50	15.50	.

Dominant species
1st dominant - *Salicornia europaea* (annual samphire) is the dominant species in all reference sites with an average cover of .20
2nd dominant - *Sarcobatus vermiculatus* (greasewood) occurs in 33% of sites with an average cover of .01

Invasive species include
Hordeum jubatum (foxtail barley) and *murinum* (rabbit barley)*, Kochia scoparia* (summer cypress), *Puccinellia distans* (weeping alkaligrass)

Species richness
Average species richness is 1-2 species. With disturbance richness climbs to 5-6 species.

Plant list for reference standard sites
Salicornia europaea (annual samphire)
Sarcobatus vermiculatus (greasewood)

Site location and vegetation scores

Site	Easting	Northing	Reference	VIBI
southdryplaya	12405656	4515582	0.75	0.88
woodscross	12420469	4526895	0.75	0.67
airport4	12411809	4519365	0.83	0.80
brownisland	12409199	4520497	1.00	0.84
lakeplaya2	12410247	4544574	1.00	1.00
lakeplaya1	12410247	4544574	1.00	1.00

Playa on The Nature Conservancy Layton Marshes at 4205 ft. It has had water 2 of the last 8 years, water was overflow from GSL.

Freshwater seasonal and persistent slopes

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5

= ratio of number of species at site found in reference standard sites / number Index of similarity of species found at site

Dominant species

1st dominant -*Eleocharis palustris* (common spikerush) in all reference sites
2nd dominant -*Distichlis stricta* (desert salt grass) 70% of sites
3rd dominant -*Juncus arcticus* (wiregrass) 60% of sites
4th dominant -*Carex nebrascensis* (Nebraska sedge) and *Scirpus americanus* (Olney's threesquare) 50% of sites
5th dominant -*Carex lanuginosa* (wooley sedge), *praegracilis* (blackcreeper or clustered field sedge) or *microptera* (small wing sedge) 40% of sites

Others species

Puccinellia nuttalliana (Nuttall's alkaligrass), *Carex simulata* (short beaked sedge), *Scirpus acutus* (hardstem bulrush), *Mentha arvense* (field mint), *Mimulus guttatus* (common monkey flower), *Sagattaria cuneata* (arrowleaf), *Ranunculus spp.* (buttercup)

Invasive species
Trifolium repens (white clover)*, Polypogon monspeliensis* (rabbitfoot grass)*, Polypogon interruptis, Hordeum marinum* (Mediterranean barley)*, Nasturtium officinale* (watercress)*, Rumex crispus* (curley dock)*, Xanthium strumarium* (cocklebur)*, Lactuca serriola* (prickly lettuce)*,* various species of *Elymus/Agropyron* and their hybrids, *Agrostis stolonifera*(redtop bentgrass), *Poa pratensis* (Kentucky bluegrass)

Vegetation species richness
In reference sites, species richness averages 13 and ranges from 10-21 species.

Descriptive Statistics reference standard slopes by salinity				
Water salinity		Minimum	Maximum	Mean
nonsaline	**species richness**	10.00	21.00	13.14
	water EC dS	1.04	7.00	3.69
	native species	1.00	1.00	1.00
	shrub	0.000	0.000	0.00
	herb	0.81	0.95	0.87
	TDS ppm	508.00	3,750.00	2175.60
	water pH	7.30	8.50	7.86
	soil pH	7.60	8.10	7.88
	soil EC dS	1.40	16.00	6.06
	soil organic carbon	1.66	11.80	6.82
	soil total nitrogen	0.09	0.63	0.35
	CN ratio	12.00	48.00	23.33
	Cadium mg/kg	0.050	0.100	0.08
	Lead mg/kg	1.240	2.790	2.02

Plant list for all reference standard slope sites
Carex nebrascensis **(**Nebraska sedge)
Carex praegracilis (blackcreeper or clustered field sedge)
Carex lanuginosa (wooley sedge)
Carex microptera (small wing sedge)
Carex simulate (short beaked sedge)
Eleocharis palustris (common spikerush)
Eleocharis rostellata (Torrey's spikerush)
Scirpus acutus (hardstem bulrush)
Scirpus americanus (Olney's threesquare)
Scirpus maritimus (alkali bulrush)
Juncus arcticus (wiregrass)
Juncus ensifolious (swordleaf rush)
Juncus torreyi (Torrey's rush)
Distichlis stricta (desert salt grass)
Agropyron trachycaulum (slender wheatgrass)
Elymus triticoides (beardless or creeping wild rye)
Sphenopholis obtusato (prairie wedge grass)
Sporobolus airoides (alkali saccaton)
Solidago missouriensis (Missouri goldenrod)
Allenrolfea occidentalis (iodine bush)
Rosa woodsii (Woods rose)

Sarcobatus vermiculatus (greasewood)
Centaurium exaltatum (Great Basin centaury)
Cicuta douglasii (water hemlock)
Comandra umbellate (bastard toadflax)
Cordylanthus maritimus (alkali birdsbeak)
Epilobium ciliatum (northern willowherb)
Iris missouriensis (Missouri iris)
Lycopus asper (rough bungleweed)
Mentha arvense (field mint)
Mimulus guttatus (common monkey flower)
Nitrophilia occidentalis (western boraxweed or niterwort)
Potentilla anserine (common silverweed)
Potamogeton spp (pondweed)
Ranunculus scleleratus/cymbalaria (blister and marsh buttercup)
Sagitteria cuneata (arrowleaf)
Salicornia europea/ utahensis (annual and Utah samphire)
Senecio hydrophilus (water groundsel)
Sium suave (hemlock water parsnip)
Suaeda depressa (broom seepweed)
Triglochin maritime (annual samphire)
Veronica americana (American brookline)

Nonsaline slope location and vegetation scores

Site	Easting	Northing	Reference	Richness	VIBI
bearriverrf2	12,411,624	4,591,521	0.75	19.00	0.67
bearriverrf2b	12,411,624	4,591,521	0.75	18.00	0.66
brigham1	12,412,115	4,594,651	0.75	13.00	0.53
gloverlane	12,423,901	4,534,960	0.67	12.00	0.37
loosestrife	12,421,789	4,523,685	0.42	25.00	0.20
fairgrounda	12,424,094	4,536,103	0.58	16.00	0.55
brigham2	12,412,778	4,594,643	0.75	11.00	0.47
fairgroundc	12,424,094	4,536,103	0.58	16.00	0.45
benjamin2	12,432,138	4,440,077	0.83	13.00	0.85
goshenbay1	12,426,300	4,428,770	0.75	13.00	0.81
goshenbay2	12,426,601	4,428,770	0.75	13.00	0.81
fairgroundb	12,424,094	4,536,103	0.58	22.00	0.52
bearriverrf1a	12,411,738	4,591,329	0.75	15.00	0.87
bearriverrf1b	12,411,738	4,591,329	0.75	15.00	0.87
perry1	12,412,406	4,592,864	0.75	15.00	0.70
perry2	12,412,406	4,592,864	0.75	16.00	0.58
golfb	12,421,732	4,525,130	0.83	10.00	0.80
golfc	12,421,732	4,525,130	0.83	11.00	0.72
quaketnc2	12,414,988	4,543,880	0.83	19.00	0.64
widgeond	12,391,114	4,602,958	0.95	10.00	1.00
deweyville2	12,410,137	4,618,868	0.83	10.00	0.65

quaketnc	12,414,602	4,543,952	0.83	19.00	0.84
deweyville1	12,409,736	4,619,723	0.83	17.00	0.64
deweyville1b	12,409,736	4,619,723	0.83	17.00	0.64
gandy2	12,249,321	4,375,542	0.90	21.00	0.90
gandy1	12,249,321	4,375,542	0.90	21.00	0.90
laytonc	12,414,485	4,543,911	0.83	23.00	0.64
laytona	12,414,485	4,543,911	0.83	18.00	0.71
benjamin1b	12,431,549	4,442,738	0.95	10.00	0.90
benjamin1	12,431,549	4,442,738	0.95	10.00	0.90
laytonb	12,414,485	4,543,911	0.83	20.00	0.70
widgeonc	12,391,114	4,602,958	0.95	4.00	0.75
golfa	12,421,732	4,525,130	0.83	11.00	0.72
widgeonb	12,391,350	4,603,011	0.95	10.00	0.90

Moderately and hypersaline persistent slopes

Vegetation index of biological integrity (VIBI) = (native/noninvasive score + index of similarity) / 2

Native/noninvasive score = ratio of native/noninvasive species in the five dominant species / 5 or the total number of dominants if less than 5.

Index of similarity = ratio of number of species at site found in reference standard sites / number of species found at site.

Dominant species

1st dominant - *Distichlis stricta* (desert salt grass) in all reference standard sites
2nd dominant -*Scirpus americanus* (Olney's threesquare) in 83% of sites
3rd dominant -*Juncus arcticus* (wiregrass) in 42% of sites
4th dominant -*Scirpus maritimus* (alkali bulrush), *Sporobolus airoides* (alkali saccaton), *Triglochin spp*. (arrowgrass) in 25% of sites
5th dominant -*Salicornia utahensis* (Utah samphire), *Cordylanthus maritimus* (alkali birdsbeak), *Eleocharis palustris* (common spikerush) in 17% of sites

Other species

Suaeda depressa (broom seepweed), *Scirpus acutus* (hardstem bulrush), *Allenrolfea occidentalis*(iodine bush)

Invasive species

Hordeum jubatum (foxtail barley), *Kochia scoparia* (summer cypress), *Elaeagnus angustfolia* (Russian olive), *Helianthus annuus* (common sunflower)

Vegetation species richness

In reference sites average species richness is 4 species, ranging from 1-7 species.

Descriptive Statistics reference standard slopes by salinity				
Water salinity		Minimum	Maximum	Mean
saline				
	water EC dS	12.70	19.90	15.91
	native species	1.00	1.00	1.00
	shrub	0.000	0.030	0.00
	herb	0.48	0.84	0.69
	TDS ppm	7,110.00	11,200.00	8630.00
	water pH	7.60	8.30	7.88
	soil pH	7.40	8.10	7.81
	soil EC dS	4.00	53.00	23.91
	soil organic carbon	1.20	12.67	4.62
	soil total nitrogen	0.08	0.45	0.21
	CN ratio	6.00	67.00	25.22
	Cadium mg/kg	0.050	0.100	0.06
	Lead mg/kg	1.460	6.080	3.18

Saline slope location and vegetation scores

Site	Easting	Northing	Reference	Richness	VIBI
widgeona	12,391,350	4,603,011	0.95	10.00	0.92
bluelake	11,751,442	4,487,440	0.86	5.00	1.00
benjamin3	12,436,336	4,443,966	0.83	6.00	0.67
horseshoeb	12,355,130	4,497,501	0.95	5.00	0.61
saltwellsr2	12,357,605	4,619,010	0.95	4.00	1.00
loco2	12,339,098	4,617,039	0.75	6.00	0.93
bluelakeupper	11,750,454	4,487,219	1.00	5.00	1.00
bluelakeuppond	11,750,965	4,487,491	1.00	7.00	1.00
goshensalta	12,423,251	4,427,893	0.95	1.00	1.00
bluelakeupspring	11,750,454	4,487,219	1.00	7.00	1.00
saltwellsr1	12,357,384	4,619,132	0.92	6.00	0.93
horseshoea	12,355,130	4,497,501	0.95	8.00	0.71
goshenssaltc	12,423,251	4,427,893	0.95	1.00	1.00
saltwellsm	12,356,043	4,621,738	1.00	4.00	1.00
saltwellsm2	12,356,043	4,621,738	1.00	4.00	1.00
goshenssaltb	12,423,251	4,427,893	0.95	1.00	1.00
saltwellsm3	12,356,043	4,621,738	1.00	4.00	1.00
bluelakeplaya	11,751,214	4,487,592	1.00	7.00	0.79
saltcreek1b	12,395,790	4,613,172	0.83	9.00	0.79
saltcreek1	12,395,790	4,613,172	0.83	9.00	0.79
jordon	12,422,106	4,483,009	0.75	7.00	0.61
saltcreek2	12,395,746	4,613,209	0.83	13.00	0.75

Plant list for all reference standard slope sites
Carex nebrascensis (Nebraska sedge)
Carex praegracilis (blackcreeper or clustered field sedge)
Carex lanuginose (wooley sedge)
Carex microptera (small wing sedge)
Carex simulate (short beaked sedge)
Eleocharis palustris (common spikerush) */rostrata*
Scirpus acutus (hardstem bulrush)
Scirpus americanus (Olney's threesquare)
Scirpus maritimus (alkali bulrush)
Juncus arcticus (wiregrass)
Juncus ensifolious (swordleaf rush)
Juncus torreyi (Torrey's rush)
Distichlis stricta (desert salt grass)
Agropyron trachycaulum (slender wheatgrass)
Elymus triticoides (beardless or creeping wild rye)
Sphenopholis obtusato (prairie wedgegrass)
Sporobolus airoides (alkali saccaton)
Solidago missouriensis (Missouri goldenrod)
Allenrolfea occidentalis (iodine bush)
Rosa woodsii (Woods rose)
Centaurium exaltatum (Great Basin centaury)
Cicuta douglasii (water hemlock)
Comandra umbelleta (bastard toadflax)
Cordylanthus maritimus (alkali birdsbeak)
Epilobium ciliatum (northern willowherb)
Iris missouriensis (Missouri iris)
Lycopus asper (rough bungleweed)
Mentha arvense (field mint)
Mimulus guttatus (common monkey flower)
Nitrophilia occidentalis (western boraxweed or niterwort)
Potentilla anserine (common silverweed)
Potamogeton spp (pondweed)
Ranunculus scleleratus/cymbalaria (blister and marsh buttercup)
Sagitteria cuneata (arrowleaf)
Salicornia europea/ utahensis (annual and Utah samphire)
Senecio hydrophilus (water groundsel)
Sium suave (hemlock water parsnip)
Suaeda depressa (broom seepweed)
Triglochin maritime (annual samphire)
Veronica americana (American brookline)

Blue Lake Slope complex, Tooele County

Widgeon Marsh slope complex, managed, Public Shooting Grounds, Box Elder County

Salt Wells Meadow, Box Elder County

Salt Creek WMA, Box Elder County

Nonnative / invasive plant species

Agropyron repens
Agrostis alba
Agrostis stolonifera
Arctium minus
Bassia hyssopifolia
Berula erecta
Bidens cernua
Bromus tectorum
Chenipodium spp
Circium spp
Conium maculatum
Dipsacus sylvestris
Elaeagnus angustifolia
Fescue arundinacea, pratensis
Helianthus annuus
Hordeum jubatum, glaucum, murinum
Kochia scoparia
Lactuca serriola
Lythrum salicaria
Melilotus alba, officinalis
Nasturtium offinale
Phleum pratense
Phragmites australis
Poa pratensis, compressa, trivialis
Polypogon monspeliensis, interruptis
Puccinellia distans
Rumex crispus
Salix babylonica, fragilis
Salsola kali
Solanum dulcamara
Sonchus spp
Stachys palustris
Tamarisk spp.
Taraxacum officinale
Thlaspi arvense
Trifolium repens, fragiferum, pretense
Typha spp
Urtica dioica
Veronica anagallis-aquatica
Xanthium strumarium